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Contents 511. Advertising Index 51

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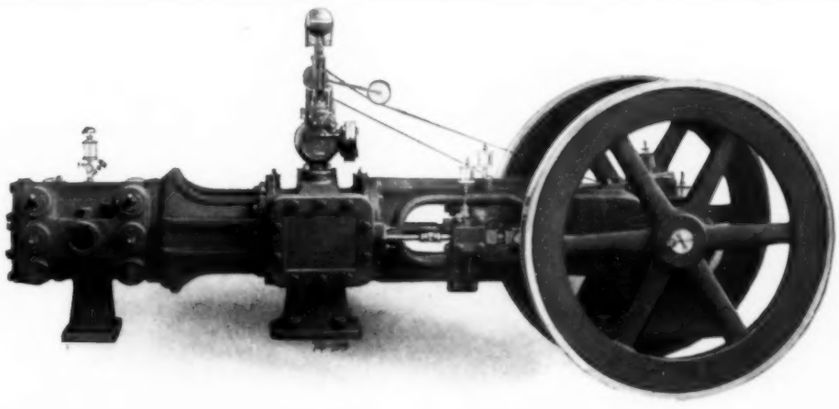

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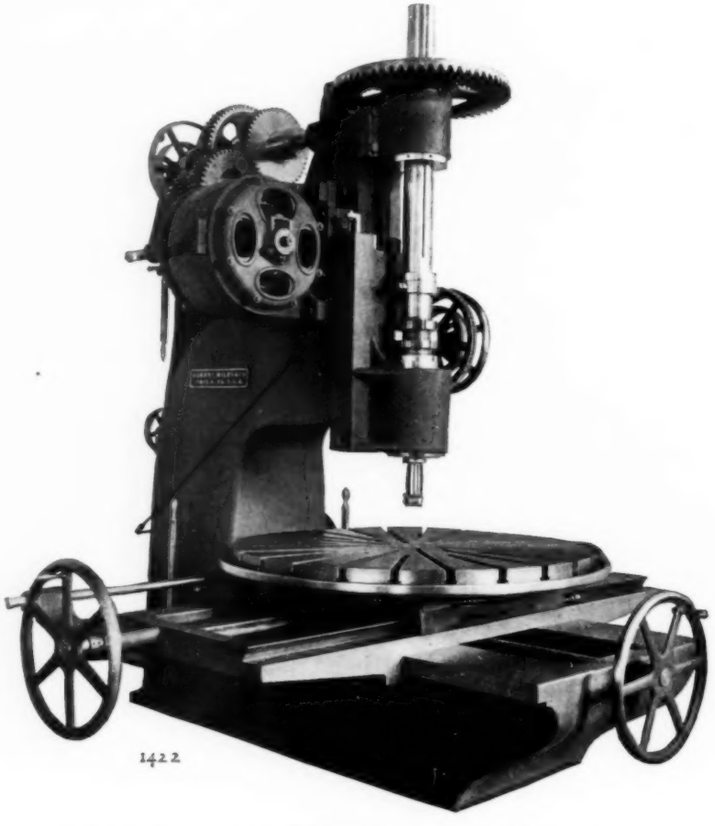

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(*See pages* 43, 44, 45 and 46)

Electric Arc Welding Processes

By C. B. Auel *

Three processes, their limitations, the apparatus used, range of work done, time required, results obtained and cautions and suggestions that, if followed, will lead to successful applications of them.

*Assistant works manager, Westinghouse Electric and Manufacturing Company.

The fusion of metals by electrical means may very properly be grouped into two general divisions, namely, arc and incandescent welding, Fig. 1. Each of these in turn is capable of subdivision, the former into the Zerener, the Benardos and the Slavianoff processes; the latter into the LaGrange-Hoho and the Thomson. Frequent mention is made in the technical press of the term "autogenous welding." Briefly defined, it is the fusing together without pressure of two metals, simply by allowing them to melt, then to mix and unite as they cool. Arc welding may be considered as a form of autogenous welding, while incandescent welding on the contrary, cannot be thus

ELECTRIC WELDING PROCESSES.

- ARC
  - *Zerener*, Arc drawn between two carbons.
  - *Benardos*, Arc drawn between metal and one carbon electrode.
  - *Slavianoff*, Arc drawn between metal and one metal electrode.
- INCANDESCENT
  - *La Grange-Hoho*, Acidulated water.
  - *Thomson*, Resistance.

FIG. 1. DIVISIONS AND SUBDIVISIONS OF ELECTRIC ARC WELDING

FIG. 2

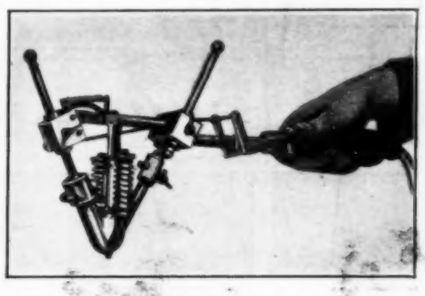


FIG. 3

FIG. 4

TYPES OF ZERENER APPARATUS

classed, as pressure is a necessary adjunct in its successful accomplishment.

ZERENER PROCESS

In the Zerener process, an arc is first drawn between two carbons by bringing them into contact with each other and then separating them a given distance. By means of an electromagnet, the arc is next directed upon the metal to be welded, which, as a result, is brought to the fusing temperature in the vicinity of the point of contact with the arc. It will be seen that the action is somewhat like that of the oxyhydrogen blowpipe, and the apparatus has in consequence, been aptly called the electric blowpipe. Figs. 2, 3, 4 and 5, which have been taken from Glaser's *Annalen* (Volume 60, 1907) show several types of these outfits, all of them bearing a close resemblance to certain makes of direct-current flaming arc lamps in which the carbons approach each other at an angle and which are further provided with an electromagnet for blowing the arc downward. In the lamps, however, the arc is spread out in the shape of a fan, to produce more light; while in the electric blowpipe, it is shaped like the point of a pencil, to concentrate the heat.

The metal to be welded is so placed that the arc may be readily directed upon it, the blowpipe either being suspended from a suitable chain or rope, or held in the hand so that it may be easily moved in any direction, toward, away from or parallel to, the work as the progress of the operation makes necessary.

On account of the difficulty in obtaining a close regulation of the arc, as well as owing to the construction of the apparatus, which does not lend itself conveniently to the carrying of large currents, the Zerener process is quite limited in its application, being usually confined to a rather narrow range of small work of the rougher kind, such as the welding or soldering of small steel and brass castings and wrought-iron plates, tubes and tanks.

BENARDOS PROCESS

In the Benardos process, Fig. 6, the metal to be welded is made one terminal of a direct-current circuit, the other being formed by a carbon or sometimes by a metallic electrode.* Upon bringing the carbon or metallic electrode into contact with the metal, thus closing the circuit and instantly withdrawing it again to a distance, an arc is drawn between the two terminals. Through the medium of the arc which produces the hottest flame known, having a temperature between 3500 and 4000 degrees Centigrade, the metal may be either entirely melted away, molded into a different shape or fused to another piece of metal as desired.

Fig. 7 shows a view of the apparatus as submitted by Benardos and Olzewski in their combined application for a United States patent (363,320) in 1885. In this $r\,r'$ represent two plates in close contact with each other and which it is desired to weld together; X is a source of electric supply, as for example a battery, with two wires leading from either terminal of it to the plate r and the metallic carbon holder $G\,G^1\,G^2$, respectively. The carbon electrode D is clamped in the metallic carbon holder at E by the set screw F, the holder itself being partially incased for insulating purposes in a wood handle or stand $A\,A'$, which is free to move or slide over the plate r. The clamp screw H enables the carbon D to be set at any desired angle. The metallic carbon holder $G\,G^1\,G^2$ is so hinged at x that by pressing the lever G^2 upward against a spring K the portion G^1 is depressed, bringing the carbon electrode D into contact with the plate r. When the carbon and the plate are thus in contact, the circuit is closed and current flows. The pressure is at once released from G^2 which allows the carbon electrode to draw away from the plate a given distance, forming the arc in so doing.

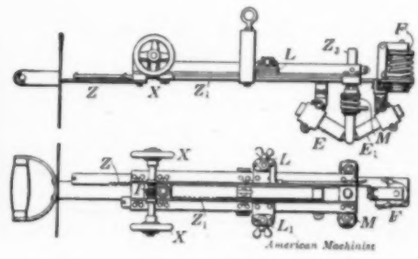


FIG. 5. ANOTHER TYPE OF ZERENER APPARATUS

Fig. 8 is a view of the apparatus accompanying the application for a U. S. patent (471,242) covering this same method of welding submitted by de Meritens in 1887. In this, a represents a cast-iron table connected by the binding screw b, to the negative terminal of an electric supply. The articles a' to be welded, as for example two plates (one of these shown as a'), are laid upon the

*See paragraph on the Slavianoff process.

table side by side in contact with each other. At *c* is the welding or soldering tool which is formed of copper or some other conductor suitably insulated by a handle *e* and provided also with a clamp *d* in which is secured a carbon electrode. The positive terminal of the electric supply is connected to the binding screw *b'*. The whole apparatus is incased in a wood box *f* fitted with a colored glass window *f'* and with ventilating device *g* for the escape of the fumes. The method of operation is practically the same as that of Benardos and Olzewski. While this process of arc welding has taken the name of Benardos and while he and Olzewski antedated de Meritens in the United States by two years, the latter preceded them in Europe by about four years.

Fig. 9 illustrates what is claimed to be an improvement over the method of Benardos and Olzewski and de Meritens submitted by Coffin in his application for a U. S. patent (401,639) in 1888. *A A'* represent the articles to be welded

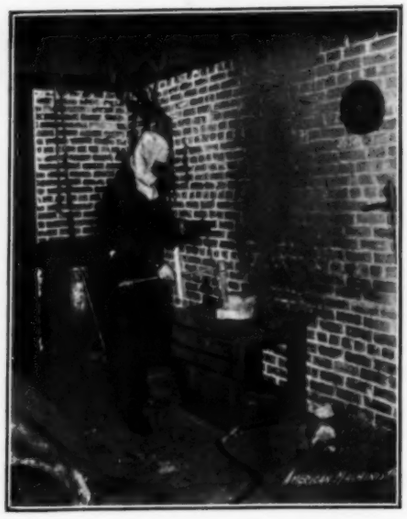


FIG. 6. BENARDOS APPARATUS

supply, the metal to be welded to the negative terminal. Practice, however, shows that it is almost impossible to maintain any but a very short arc with the terminals so arranged; and further, the flow of current from positive to negative, particles of carbon will find their way into the welds, thus tending to make them crack upon cooling or else exceedingly hard and consequently difficult to machine. By reversing the terminals and making the metal to be welded the positive, the carbon electrode the negative terminal, not only can a longer arc be maintained but a large part of the trouble due to hardness will disappear. Perhaps the most important advantage to be derived by making the metal to be welded, the positive electrode, lies in the well known fact that in a direct-current carbon arc the greatest energy consumption and, therefore, the highest temperature occurs at this terminal. While no very extended data are available regarding the behavior of arcs having either or both electrodes of metals, there is considerable data with reference to carbon arcs and it is fair to assume that in regard to this particular feature of energy consumption, there is not a wide difference between them. Accordingly the accompanying curves, Fig. 10, compiled by C. E. Stephens, of the Westinghouse Electric and Manufacturing Company, will be of interest, as showing the relative percentage of energy consumption at the two electrodes of short carbon arcs with varying current flowing. To account for the peculiar distribution of energy, several theories have been advanced. One of these assumes that the resistance of the vapor in the immediate vicinity of the positive electrode, is considerably greater than at any other portion of the arc; and, therefore, the energy expended, with its resulting temperature, is very much higher at this point.

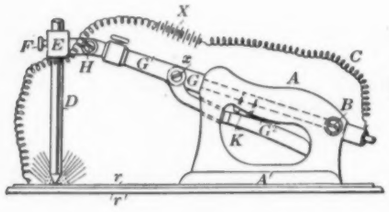


FIG. 7. BENARDOS AND OLZEWSKI APPARATUS

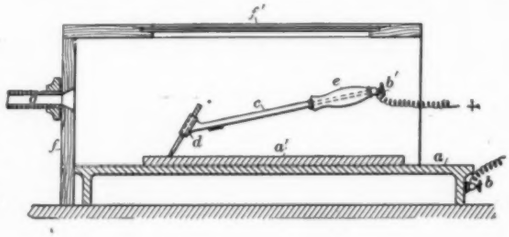


FIG. 8. DE MERITENS APPARATUS

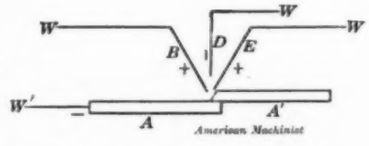


FIG. 9. DIAGRAM OF COFFINS APPARATUS

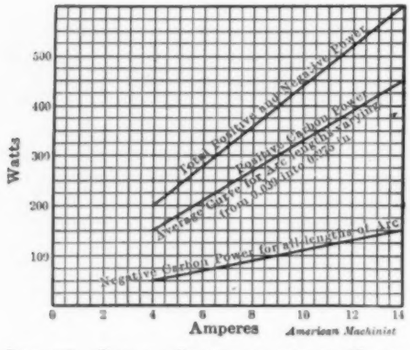


FIG. 10. POWER CONSUMPTION IN ELECTRIC ARC WELDING

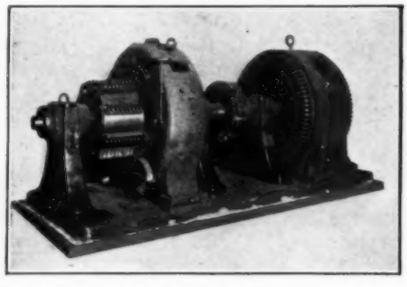


FIG. 11. 200-KW. MOTOR GENERATOR FOR ARC WELDING

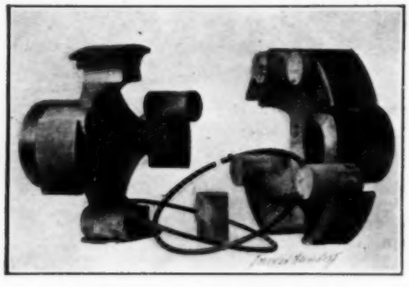


FIG. 12. COUPLING BETWEEN MOTOR AND GENERATOR

and *B*, *D* and *E* the carbon electrodes, the latter, of course, being carried in suitable holders. The articles to be welded and the carbon electrodes are connected to terminals of an electric supply as indicated by the + and — signs. As a result, a system of manifold arcs is obtained, for example, between *A* and *B*, *B* and *D*, *D* and *E*, *E* and *A'*, thus facilitating the work. The last method has, however, never come into practical use.

In the preceding patents, it will be noted the carbon or metallic electrode is specified as preferably being connected to the positive terminal of the electric

APPARATUS REQUIRED FOR THE BENARDOS PROCESS

A complete outfit for the Benardos system of arc welding, embraces a suitable direct-current supply with its controlling apparatus, carbon electrodes of various diameters, protective coverings for the operator and the work, fireclay or carbon blocks for molding purposes, a flux and material to serve a filler.

CURRENT SUPPLY

The required direct current may be obtained in any of several ways; from a 100-volt independent dynamo driven either by an engine or a motor; from similar public supply mains; from a bat-

tery operated in conjunction with either of the preceding; or current may even be obtained from a higher voltage supply than indicated, if this is the only kind available, though the last mentioned is naturally very wasteful and can only be recommended where the amount of welding to be done is so small or so infrequent as not to warrant one of the other methods being employed. In general the supply should not be less than 75 to 100 kilowatts. The dynamo may be shunt or compound wound, preferably the latter; and, if of the direct-connected type instead of belted, a flexible coupling should be used to reduce the strain on the apparatus when sudden loads are thrown on and off, as when the circuit is closed by touching the carbon electrode to the metal to be welded. Fig. 11 shows a direct-connected motor-driven dynamo of 200 kilowatts capacity for welding purposes, the details of the coupling being illustrated in Fig. 12. This latter consists simply of two spider-like interlocking arms, one mounted upon the shaft of the motor, the other upon that of the dynamo and separated from each other by several cylinders of solid rubber which are in turn held in position by key-rings and which absorb shocks to a very considerable extent.

The combination of a battery and a dynamo is very seldom used, Fig. 13, as a source of electricity supply in work of this kind, for the special advantages are generally so small that the additional expense is not justified. It will be readily appreciated, however, that for a given output and intermittent working, a smaller dynamo will be required with a battery than without one, and the dynamo will always run at its full capacity. During periods of minimum working or of no load, it will be used either partly or wholly in charging the battery, while during periods of maximum load, it will add its full output to the full output of the battery, thus giving a most efficient installation.

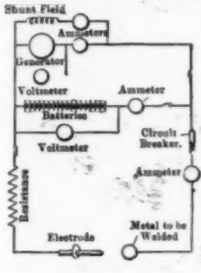


FIG. 13. BATTERY AND MOTOR CONNECTIONS FOR ARC WELDING

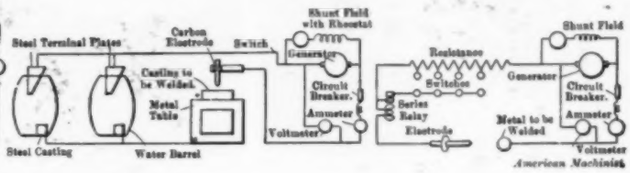


FIG. 14 FIG. 15

WATER BARREL FOR ARC-WELDING CURRENT

FIG. 16. WATER BARRELS FOR ARC-WELDING CONTROL

CONTROLLING APPARATUS

As different welds require different strengths of current, it will be at once evident that there must be some means of regulating the current supply. This is usually effected by the introduction of resistance into the main or armature circuit, though sometimes when an independently driven dynamo is employed, its field may be weakened instead, thereby reducing both voltage and current. Furthermore, even if all welding were of such a nature as to require approximately the same current, it would still be necessary to introduce resistance in order to prevent short circuiting of the dynamo at the moment of closing the circuit when striking the arc.

This will be more plainly seen in studying the accompanying diagrams, Figs. 14 and 15, which show two methods of controlling the current, one by the use of water-barrels or grid resistance in which the total resistance is adjustable but once as a usual thing for any weld and is then left in the circuit during the entire time the weld is being made; in the other, the current is regulated by the use of a relay which operates to cut out a part or even all of the resistance the instant the circuit is closed. While the former method is by far the more common, the latter is much the more satisfactory and economical, though slightly more expensive in the first cost.

Discussing these diagrams in detail, in Fig. 14 one branch of the circuit leads from the dynamo or other source of electric supply, through a circuit breaker and an ammeter direct to the carbon electrode which forms the terminal, the other branch of the circuit leads from the dynamo (generally through a single-pole switch) to the main rheostat, in this instance consisting of two water-barrels instead of grids, through this rheostat to

*See paragraph in the "Slavianoff Process."

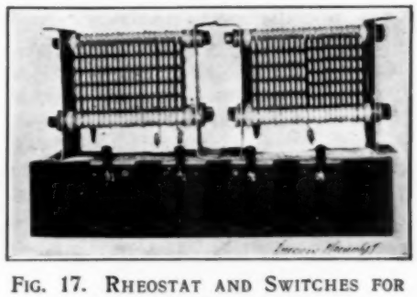


FIG. 17. RHEOSTAT AND SWITCHES FOR ARC-WELDING CONTROL

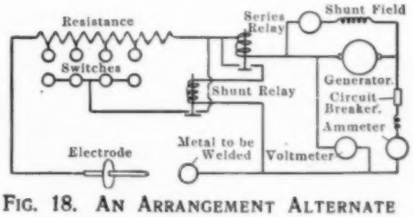


FIG. 18. AN ARRANGEMENT ALTERNATE WITH FIG. 15

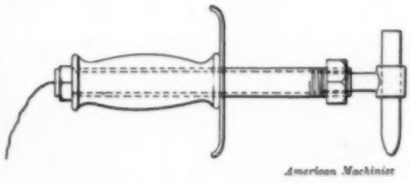


FIG. 19. ELECTRODE FOR ARC WELDING

FIG. 20. ANOTHER FORM OF ELECTRODE AND RESISTANCE

Arc Length in Inches.	Volts across Arc, Including Carbon.	Current in Amperes.	Length of Carbon in Inches.
6	101	300	1x6½
5	98	350	
4	93	400	
3	86	605	
2	80	750	

FIG. 22. VARIATIONS OF VOLTAGE AND CURRENT FOR ARCS OF DIFFERENT LENGTH.

the metal to be welded which becomes either directly or through the medium of a metallic table, the other terminal. The water-barrels, Fig. 16, are provided with pulleys and counter weights by means of which the distance between the terminal plates may be varied and the resistance in the circuit increased or decreased accordingly. While water-barrels serve their purpose fairly well, the water will, when the plant is worked very hard, occasionally boil over, necessitating stoppage of the work to allow the water to cool; the bands too, on the barrels rust away, thus requiring new barrels every few months. It will be found, further, that the resistance of the water is not constant, being greater when cold than when hot, and this will sometimes involve a readjustment of the distance between the plates, after the water has become hot.

In Fig. 15 the water barrels with their adjustable plates have been replaced by a grid rheostat and a series relay. The rheostat is provided with several switches (detailed in Fig. 17) by which the resistance can readily be altered. When the circuit is first closed the entire resistance of the grids is in the circuit, regardless of the position of the adjusting switches. The dynamo is thus protected from a short circuit. The instant, however, contact is made and the arc sprung, the series relay acts to cut out a part or even all of the resistance, depending upon which one of the adjusting switches is closed; in this way the dynamo is saved not only from the severe strain to which it is subjected when closing the circuit under the first arrangement, Fig. 14, but a certain loss is also avoided by not retaining in circuit a resistance which becomes unnecessary after the arc is sprung. In using this latter method, there is the remote possibility that after the arc is sprung and the resistance cut out of the circuit, the operator may accidentally bring the carbon electrode back into contact again with the metal being welded, which forms the other electrode, thus producing a short circuit on the dynamo; in practice, however, it will be found that no trouble need be anticipated from this source.

In Fig. 18 is shown a similar arrangement, except that the series relay operates to close a shunt relay, which in turn cuts out the resistance. This has no advantage over the more simple scheme shown in Fig. 15, and is only mentioned as it is sometimes more convenient to purchase standard relays in this form than in the other, the details of the series relays being, of course, quite different in the two cases.

FIG. 21. BRIGHTNESS OF ELECTRIC ARC

FIG. 23. TEMPORARY FURNACE BUILT AROUND LARGE WORK TO BE ARC WELDED

FIG. 24. LOCAL PREHEATING PRIOR TO ARC WELDING

CARBON ELECTRODES

The type of electrode most commonly used is that shown in Fig. 19, consisting of a piece of pipe threaded and insulated as shown, and into which is fitted a suitable carbon rod. The carbon will vary from ¼ to 1½ inches in length, though both of these dimensions may be exceeded in special cases. The carbons should be hard and solid (uncored) and in burning away should leave a rounded end instead of a pencil point. It is usual to clamp the carbon about 4 to 6 inches from its point, simply to reduce the resistance somewhat.

In another type of carbon electrode, Fig. 20, manufactured by the Electric Controller and Manufacturing Company, there is a button located in the handle within easy reach of the operator's thumb and which when pressed closes an auxiliary circuit, bringing into action two solenoids. These in turn close the main circuit but keep it closed only as long as

FIG. 25

FIG. 26

FIG. 27

ARC WELDING A LUG TO A STEEL CASTING

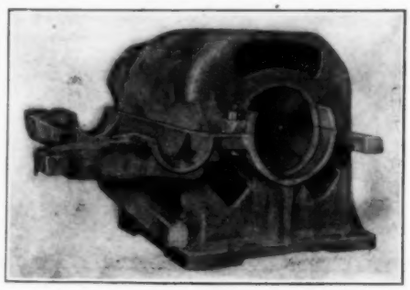


FIG. 28. DEFECTIVE STEEL CASTING CORRECTED BY ARC WELDING

the pressure is retained on the button. In this way short circuits are guarded against in case the electrode is accidentally dropped or carelessly set down.

Protective Coverings for Operator and Work

On account of the intense brightness of the arc, Fig. 21, the welding requires to be done in an inclosure so as not to interfere with any other work in the vicinity. No special provision need be made for taking care of the fumes, as these cause practically no difficulty. The operator, too, must be thoroughly covered—head, hands and body. It is not alone sufficient as in the case of oxyacetylene welding, simply to shield the eyes with a pair of colored glasses. Exposure to the rays of the arc causes an irritation of the skin very much like sunburn, the skin reddening and subsequently peeling, if the exposure has been sufficiently long, say, several minutes. The irritation is accompanied by a stinging or burning sensation over the area of the exposed surface, but with, however, no more serious consequences and at the end of a few days all trace of the burn will have disappeared.

To protect the body, the clothing is ample; for the eyes, a covering either of canvas, wood or stovepipe and fitted with a small projecting window of thick colored glass is worn over the head while the hands and wrists are shielded by gauntleted gloves of pigskin or buckskin. The window of the hood should be provided with several pieces of glass in layers, one or more of red and one or more of blue; or one or more of green may be substituted for the blue, the combination of these colors being much more satisfactory than any of them used alone. The canvas and the stovepipe hood are both open to some objection, the former on account of the lack of ventilation, the latter owing to the possibility of touching the carbon electrode to it in a moment of carelessness and thus receiving a disagreeable shock. The window of the hood should be made to project at least an inch, as the glass will in due course become quite hot; and, if too close to the eyes, will inflame them. The wood shield has likewise an objection in that it is usually held in one hand, thus reducing in large measure the use of that member; it may, however, be arranged to rest entirely on the shoulders when, aside from its clumsy appearance, it answers the purpose very well.

Brand and Size. F. = Fire-welded. E. = Electric-welded. Brand.	Inches.	Ultimate Tensile Strength per Square Inch. T Tons.		Contraction of Areas at Fracture. C Per Cent.		Extension in Ten Inches. Per Cent.		Ratio of Weld to Solid. Per Cent.		Figure of Merit. $T \times C$	
Lowmoor iron	2x⅝	F. 20.3	E. 21.1	F. 15.2	E. 17.3	F. 7.3	E. 7.3	F. 77.9	E. 81.1	F. 308	E. 365
Lowmoor iron	2x⅝	F. 21.5	E. 21.8	F. 22.3	E. 20.7	F. 11.3	E. 9.7	F. 90.7	E. 91.8	F. 479	E. 451
Netherton best iron	2x ½	F. 18.4	E. 20.1	F. 10.1	E. 10.8	F. 3.4	E. 4.5	F. 84.4	E. 92.0	F. 185	E. 217
Parkgate steel	2x ½	F. 20.9	E. 22.3	F. 9.3	E. 18.4	F. 1.9	E. 3.8	F. 69.1	E. 73.6	F. 194	E. 410
Parkgate steel	2x ½	F. 20.4	E. 21.0	F. 15.9	E. 15.4	F. 8.1	E. 7.3	F. 82.3	E. 86.4	F. 324	E. 323
										1490	1766

$$\frac{\text{Average of electric-welded bars} = 1766}{\text{Average of fire-welded bars} = 1490} = 118.5 \text{ per cent.}$$

FIG. 29. MAIN RESULTS OF TESTS OF FIRE-WELDED COMPARED WITH ELECTRIC-WELDED BARS.

Section.	Smith Welded.	Arc Welded.
1 x1½"	$0.59	$0.51
1½x1½"	0.66	0.30
1½x2 "	1.13	0.45
1¾x2½"	1.25	0.45
2 x6 "	3.05	0.85

FIG. 31. LABOR COSTS OF BLACKSMITH VERSUS ARC WELDED RINGS.

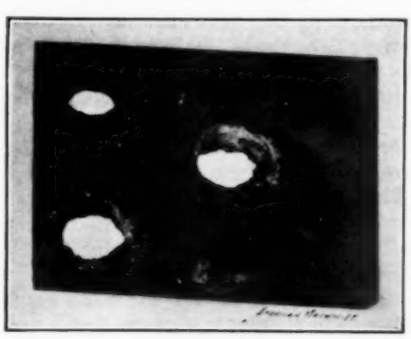


FIG. 34. HOLES CUT WITH ELECTRIC ARC

FIG. 32. SINK HEAD OF STEEL CASTING —CUTTING DONE WITH ELECTRIC ARC

Line Volts.	Amperes.	Volts across Rheostat.	Volts across Arc, Including Carbon.
120 (open circuit)	....	..	..
98	430	23	72
102	400	22	81
104	370	20	86
85	1000(kick)	24	60
87	1000(kick)	35	63

Size of hole = 1¾ inches diameter x 1½ inches deep. Size of carbon = 1½x6 inches. Time = 3 minutes, 30 seconds (includes 45 seconds for reversing plate).

FIG. 35. BURNING HOLE IN WROUGHT-IRON PLATE.

Flux

A very good flux for wrought, cast and malleable iron and steel of all kinds, consists of a mixture of 15 to 25 per cent. of red oxide of iron (Fe_2O_3) and 85 to 75 per cent. of borax ($Na_2B_4O_7 + 5H_2O$). The theory in connection with its use is that any carbon which may have been introduced into the weld from the carbon electrode, will unite with the oxygen in the flux to form carbonic dioxide gas (CO_2), leaving as a residue, pure iron. If, however, the gas should not be entirely eliminated, it will cause sponginess in the metal. The borax simply tends to prevent oxidation by excluding the air. In the use of borax as a flux, much better results will be obtained if the water of crystallization of which it contains about 47 per cent. is first removed. This can be easily accomplished by melting the borax in a graphite crucible until it is free from bubbles, then pouring it out, allowing to cool and finally pulverizing it. Used in this way, it does not swell, makes a much better flux and helps to give a more perfect weld; for brass, lead or zinc welding, it is sufficient to use borax alone.

Line Volts.	Amperes.	Volts across Rheostat.	Volts across Arc, Including Carbon.
126 (open circuit)	....	..	..
102	550	38	63
102	500	36	65
102	550	39	61
98	600	42	53
97	650	44	51
97	650	45	50
102	600	42	58

Size of hole = 1½ inches diameter × 2 inches deep. Size of carbon = 1½ × 6 inches. Time = 56 seconds.

FIG. 30. BENARDOS PROCESS—FILLING DRILLED HOLE IN AXLE CAP.

Line Volts.	Amperes.	Vo ts across Rheostat.	Volts across Arc, Including Carbon.
120 (open circuit)	....	..	..
95	600	34	62
98	650	30	67
100	600	31	67
95	850 (kick)	30	64
100	850	30	71
100	850 (kick)	35	63

Cross-section of sink head = 2¼x6 inches. Size of carbon = 1¼x6 inches. Time = 4 minutes, 45 seconds.

FIG. 33. REMOVING SINK HEAD FROM AXLE CAP.

FIG. 36. ELECTRIC ARC-WELDED PIPE FLANGE

Filling Material

Material of the same kind as the metal to be welded, is generally used as a filler. For wrought iron and steel, the filling material may be soft-iron rod, punched-iron scrap (boiler plate) or broken bits of steel castings; for cast and malleable iron, soft-iron rod, punched-iron scrap, copper or special cast iron high in silicon may be used; for brass, lead and zinc, rods or castings of the same material will do.

Method of Making a Weld

When arranging for a weld, the piece may be laid upon the metallic table, previously referred to in Fig. 14 and which forms the positive terminal; or, if more convenient, the table may be omitted and the positive cable fastened directly to the piece which thus becomes the positive terminal. The resistance of the circuit is next adjusted to what is deemed the proper amount, in the case of the water rheostat by raising or lowering the terminal plates; or, when a grid rheostat is employed, by opening or closing the various adjusting switches, thus cutting into or out of the circuit a certain number of grids. The circuit breaker and the single-pole switch (if one of these is used) are next closed. The operator then assumes his position in front of the metal to be welded, taking the carbon electrode in one hand and having within easy reaching distance of the other hand, the flux and the filling material. He finally pulls the hood down over his head, touches the carbon electrode to the metal to be welded, thereby closing the circuit, and instantly withdraws it to a distance of two or more inches, thus striking the arc. With a long arc, there is less opportunity for carbon particles to enter the metal, and in this way to produce a hard weld; the heating effect also, is more regular and more evenly distriuted. For these reasons the arc should be as long as possible, four inches being a not unusual length. If difficulty is encountered, either by the arc going out frequently or by proving too fierce, the resistance in the circuit must be decreased or increased accordingly.

Fig. 22 will enable an idea to be formed as to the manner in which the voltage and the current vary with the length of arc. After the arc is sprung, it is allowed to play upon the piece, being given a rotary motion by hand. The object of this motion is to heat a comparatively large area of the surface about the weld, so that the subsequent cooling will take place more slowly and there will be less danger of cracking or of making a hard weld. When the Benardos system of welding was first introduced commercially, the carbon electrode was sometimes so arranged that, while held in the hand, it was given a gyroscopic motion over a limited area by means of a belted mechanism; but merely rotating the carbon electrode slowly by hand has been found to answer the purpose equally well, and the more complicated mechanism has in consequence, passed out of use. When the metal boils, the flux and the filling material should be added, a little at a time, the arc, of course, being continued meanwhile, until the metal is thoroughly melted and the weld made. As soon as the metal commences to cool, it must be hammered thoroughly either by hand or by power, in order to prevent sponginess, and to give the metal a finer grain. All oxide and other impurities must be kept out of the weld; it is advisable, therefore, to make, if possible, one continuous application of the arc. When, however, more than a single application is necessary, care should be observed to remove all of the scale, and this may be readily done by means of a stiff-wire brush. Similarly, the metal should be clean before commencing a weld. To accomplish this, chipping may be resorted to or the piece may be tilted, the arc applied and the impurities as fast as melted, allowed to run off by gravity.

General

Heating the metal preparatory to making a weld, is always beneficial but is not essential except with cast and malleable iron; and, even in the case of these two metals, there will be exceptions which prove the rule. In preheating, it is preferable to have for small work, a furnace, in which the metal to be welded is placed and then slowly heated to a cherry red. The top of the furnace is removed at the proper time, and the weld made without taking the metal from the furnace. After this and before taking the piece from the furnace, it is allowed to cool slowly. For large work, too bulky to be placed in a furnace of this kind, a temporary furnace of ordinary firebrick piled loosely one upon the other without cement, Fig. 23, may be built around the piece, suitable ports being provided which, when the metal has reached a cherry-red condition, may be uncovered and through which the carbon electrode may be inserted and the weld thus made. Sometimes local preheating as shown in Fig. 24 will be sufficient.

In building on a lug, a mold is first made either of fire clay, sheet copper, or carbon blocks cut to the desired shape. Figs. 25, 26 and 27 show a cast-steel bearing cap, the lug on which has been added in this manner.

Fig. 28 is that of a casting received from the steel foundry without the strut supporting the axle bearing bracket, which defect was readily remedied by welding on a wrought-iron arm.

When welding brass, lead or zinc, the metal must be supported in such a manner that the shape will be retained. The arc, too, should be applied at a very low voltage and for a very short space of time, otherwise these metals on account of their comparatively low fusing points, will be melted away.

In the welding of iron and steel, it not infrequently happens that the welds are either so very hard as to be incapable of machining, or else are interspersed

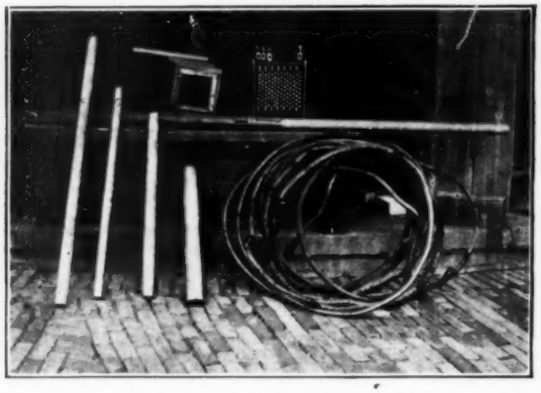


Fig. 37. Apparatus Used to Open Furnace Tap Hole with Electric Arc

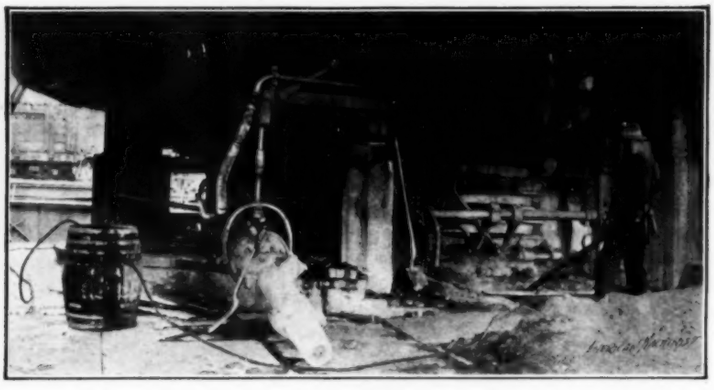


Fig. 38. Opening a Furnace Tap Hole with Electric Arc

with blowholes. Of course, where no machining is required, hardness is immaterial; and, as a matter of fact, may even be of advantage, as in the case of steel rolls. In any event, however, it may be taken for granted that inability to attain good results is due to failure to observe one or more of the several precautions already mentioned and which are here repeated for the sake of emphasis:

1. The positive terminal should always be fastened to the metal to be welded, the negative terminal to the carbon electrode.
2. The arc should be as long as possible.
3. The weld should be made with the fewest possible applications of the arc.
4. The arc should be given a rotary motion by hand so as to heat as large an area as possible instead of being concentrated on one spot.
5. The metal to be welded should be free from dirt and slag before commencing to weld and be kept thus at all times.
6. A suitable flux should be judiciously used.

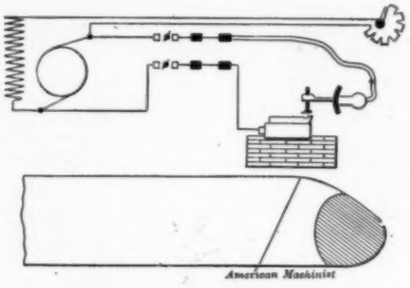


FIG. 39. DIAGRAM OF ELECTRIC APPARATUS TO HEAT A TOOL FOR HARDENING

7. Vigorous hammering should invariably accompany the making of each weld.

COMPARISON OF ARC AND BLACKSMITH WELDS

In order to enable a comparison to be made between the strength of blacksmith or fire welds and arc welds, the results obtained in a series of tests made under the supervision of Messrs. David Kirkaldy & Son for Messrs. Lloyd & Lloyd, Birmingham, Eng., are reproduced in Fig. 29. The bars were all scarf welded, the scarfs being about 1½ inches long. The data given represent the mean of tests on 210 arc-welded bars and on 50 blacksmith-welded bars. Taking as a "figure of merit," the ultimate tensile strength multiplied by the contraction of area at the fracture, it will be seen that the mean of the arc welds is 18.5 per cent. better than the mean of the blacksmith welds; and, further, that the strength of the arc welds ranges from 73.6 to 90.0 per cent. of that of the original stock, while the blacksmith welds are not quite so high.

It is exceedingly difficult to give exact statistics as to the length of time required to make welds, the current consumption, the sizes of welds, costs, etc. Figs. 30 and 31 will nevertheless afford some ideas of these various items, but are given as approximations only.

OTHER USES OF BENARDOS PROCESS

In addition to the welding of metals, the Benardos process is oftentimes employed to advantage along quite different lines; for example, in cutting away surplus metal, in removing heads from castings, Figs. 32 and 33; for boring holes, Figs. 34 and 35; for flanging pipes, Fig. 36; for opening the tap holes and the tuyeres in furnaces, for hardening high-speed tools, etc. When used for opening tap holes the furnace is made the positive terminal of the circuit. The negative terminal consists of a solid carbon rod two inches in diameter by 48 inches in length, fitted to one end of a wrought-iron pipe which, at its other end, is provided with a wood handle, the whole being about 10 feet long. Into the negative side of the circuit is introduced a grid resistance, immersed in a barrel of water. The apparatus and the method are shown in Figs. 37 and 38, both of these views are shown by courtesy of the United States Steel Corporation. With a current of 800 amperes, about 30 inches per hour may be burned away. Sometimes in burning a tuyere, cinder is met with. As this is a nonconductor, it becomes necessary to drive into this cinder, by means of a sledge, an iron rod until fused iron is encountered. The burning is then resumed along the iron rod. Care must be taken in clearing either a tuyere or a tap hole, that as the operation approaches completion, molten metal and cinder will not be blown out from the furnace upon the operator.

In a paper entitled "The Development and Use of High-Speed Tool Steel," by J. M. Gledhill, read before the Iron and Steel Institution (England), the application of the Benardos process to the hardening of tools is described, from which the following is taken: "The tool under treatment (Fig. 39) and the positive electrode are placed on a bed of nonconducting and noncombustible material and the arc started gradually at a low voltage and steadily increased as required, by controlling the shunt rheostat, care being taken not to obtain too great a heat and so fuse the end of the tool. The negative electrode should be kept moving over the surface without approaching too near the cutting edge." It must be admitted, however, that considerable skill is required to obtain results in this class of work.

SLAVIANOFF PROCESS

In spite of apparently the best of care, hard welds will at times be encountered either with the Benardos or the Zerener process, due in the main to carbon from the electrode entering the welds. Slavianoff, in endeavoring to overcome this difficulty, modified the Benardos process by substituting for the carbon electrode, an electrode of the same material as the metal to be welded. While in general the rest of the process is the same as the Benardos, there are a few important differences which must be carefully observed if the desired results, namely, soft welds, are to be obtained. For welding iron or steel, the electrode should be of the best grade of soft-iron wire not exceeding 3/16 to ¼ inch diameter, about 12 inches long, and should, moreover, be covered with a suitable paste or flux, which has been allowed to dry on it before using.

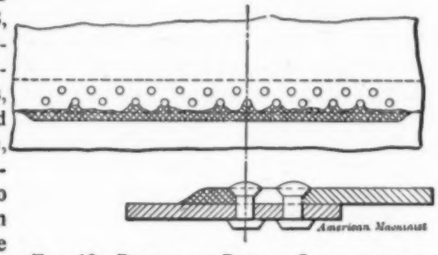


FIG. 40. REPAIR OF BOILER SEAM MADE BY ELECTRIC ARC

A flux originated and used by the Westinghouse Electric and Manufacturing Company with good results, especially in welding cast and malleable iron, consists of 5 per cent. of oxide of copper (CuO), 15 per cent. of oxide of manganese (MnO_2), 30 per cent. oxide of iron (Fe_2O_3) and 50 per cent. of borax ($Na_2 Bo_4 O_7 + 5 H_2O$). The ingredients should be mixed and applied dry during welding, being sufficiently fine to pass through an 80-mesh sieve. A direct current of about 130 amperes, at 24 to 26 volts directly across the arc, will be found best adapted for this process. The arc itself, instead of being a long one, as in the Benardos process, is exceedingly short, not over ⅛ or 3/16 inch in length. Some little skill is required in

	Breadth in Inches.	Width in Inches.	Area in Inches.	Ultimate Tensile Strength in Tons. Total.	Per Square Inch.	Extension in 4 Inches, Per Cent.	Cold Bend, Degrees.
Unannealed.....	1.0	0.56	0.56	15.3	27.4	12	58
Annealed.....	1.0	0.55	0.55	14.5	26.3	14	160

FIG. 41. TESTS OF BOILER PLATE WELDED BY ELECTRIC ARC.

manipulating the electrode in order to prevent its sticking to the metal being welded, when the arc is struck. It is advisable to rest the arm on a support when about to make a weld, then to bring the electrode as close as possible to the metal to be welded, without actually coming in contact with it, after which the hood should be drawn fully over the head, and finally the electrode barely touched to the metal and instantly pulled back, both of these movements being accomplished by means of the wrist. It is, of course, quite evident from what has been said, that the same volume of work cannot be accomplished in a given length of time with this process as with the Benardos process; but, where machining must subsequently be performed, or where the material is thin, it will in many cases prove to be the better method.

In a paper by H. Ruck-Keene, entitled "New Methods of Effecting Boiler Repairs," read before the Institution of Marine Engineers, England, there is described the Slavianoff process, as applied to the repairing of marine and land boilers. Figs. 40 and 41, taken from this paper, show the repairs made to the wasted seam of a land boiler, as well as the results of tests on a plate welded in this manner. The same process has also been outlined at some length by A. Scott Younger before the Institution of Engineers and Shipbuilders, Scotland, in a paper subjected, "Steamship Repairs by Electric and Autogenous Welding."

In conclusion it may be said that arc welding covers a field entirely its own, and quite distinct from those occupied by incandescent and by oxyacetylene welding, neither of which can infringe with advantage upon it.

Dipping Drawing Stand Parts

By L. W. Rawson*

For some time the Washburn shops of the Worcester Polytechnic Institute have been studying their various products for the purpose of increasing the efficiency in their manufacture. In doing this one machine at a time has been taken and a study made of the various operations necessary to complete each piece composing that machine. In taking up the study of a machine in this way, the cost of certain parts or operations usually appears excessive in proportion to other parts or operations of this machine, and these are the ones to receive first attention.

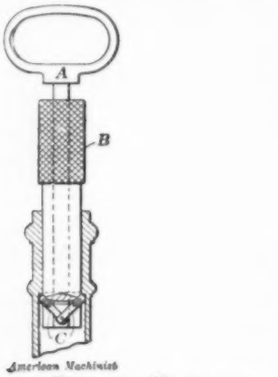


Fig. 1. Lifting Tool for Handling Drawing-stand Tripod and Post

One of the products of the shops is

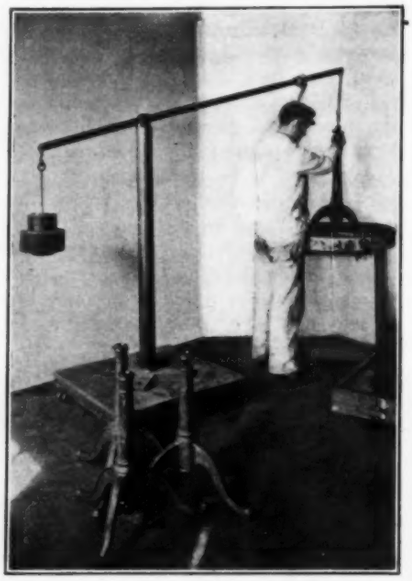


Fig. 2. Dipping Tank and Sweep for Tripods and Posts

drawing stands made up in lots of 200.

In analyzing the cost of the manufacture of these stands the cost item which stood out most prominently was the painting. This consisted of brushing two coats of varnish paint and decorating. This brush work required from 45 to 50 hours for 100 stands or about 15 minutes per stand per coat. This time includes the necessary preparation of the stand in order to give a smooth surface. To decrease this time by any appreciable amount would mean considerable extra effort on the part of the brush hand, and, as we believed he was turning out a fair day's work, we decided to try some method of dipping.

The Work

The stands weigh about 50 pounds, and the first problem was how to handle them. It was determined that it would be better to remove the spindle and top and treat the tripod and post as one unit and the spindle and top as another. The post and tripod are entirely covered with enamel, and to handle this when freshly coated, a lifting tool, shown in Fig. 1, was designed. The handle *A* is attached to a spindle which passes through a nurled sleeve *B*, and to the ends of this spindle are attached two dogs *C* which are slotted and through which slot are pins fastened to *B* so that by lifting the handle *A* draws the dogs up to project beyond the diameter of the sleeve *B* and engage on the shoulder of the chamber of the post and lift it, while pushing down on *A* and lifting on *B* allows the tool to be withdrawn from the post.

The Dipping Tank

The dipping tank was made in the form of a letter *Y*, the three legs being of equal length and at 120 degrees to each other, this construction saving much in initial cost of painting material. In order that the material may not evaporate or become skimmed over while not in use, a water seal is provided. This consists of a circular pan fitted around the Y-tank and filled with water, and into this pan a cover is placed when not in use.

The halftone, Fig. 2, shows the stand being lowered into the tank held by a tool similar to that shown in Fig. 1 and attached to the end of a chain on the arm of the sweep. This tool, however, has a safety lock so that it cannot become disengaged except at the will of the operator. The sweep is made with a cone bearing in order that it may swivel easily. This sweep is mounted on a carriage, as is also the enamel tank, so that they may be moved along to the stands. The arm of the sweep is counterweighted so that its lifting power is slightly less than the stand. When the arm is in its lowest position either for picking up or removing a stand, it is locked and there is no danger that the counterweight will raise the arm before it is intended to do so. This lock catches automatically and is unlocked by a trigger on the arm close to the chain. As soon as the stand has been

Fig. 3. Dipping Smaller Parts

*Superintendent, the Washburn shops, Worcester, Mass.

dipped it is allowed to drip for about half a minute and is then put on the carriage, also illustrated, and the surplus enamel allowed to run off. After about eight of these stands are dipped, the carriage is run to the storage place and the stands removed by the lifter tool previously described. Other parts which are being enameled show in Fig. 3.

Savings in Time

This process has now been running for about a year and has resulted in a saving of from 60 to 65 per cent. in time. The finished work is also much smoother than is possible by hand.

In designing the apparatus just described, the length of time that it would be in operation during each month was taken into consideration. A much more elaborate and possibly a little more efficient means of handling might have been installed, but as the apparatus is in use not more than 10 per cent. of the time, the one described was considered to be the most economical.

Re-expanding Condenser Tubes

By Frank S. Bunker

An apparatus by which old surface-condenser tubes, instead of being thrown away, may be reexpanded at their ends so as to be practically as good as new.

Reexpansion of the metal makes it stiffer than the original tubes.

Rigs for sawing and hydrostatic testing.

When a steam condenser has to be retubed it costs money in many ways; labor, new tubes, and the absurd price which old tubes are worth as scrap. The following description may be of use to many, as it explains the process of rejuvenating old tubes and using them again; although not always in the same condenser.

Tubes generally are found with the ends crushed in by the packing, which not only causes a reduction in area of the tube, but also necessitates a large size packing. This is poor practice, as the larger packing tends still further to crush the tube.

In Fig. 4 will be seen a rig which is used on the Pacific coast to roll the interior of the tube back to its original size. This rolling hardens the metal in the tube and gives it greater power to resist the crushing effect of the packing. The rig was made by placing two small speed lathes tail to tail, with the headstocks in line. One lathe was bolted securely to the floor, and the other secured in slides which allowed the lathe to be moved to admit of longer or shorter tubes being handled.

Block *a*, Fig. 4, is mounted on the shears of the lathe and securely held there on a proper fitting, in a central position. This block is of tool steel, hardened, and is hinged to allow of opening to admit the tubes. A half-round groove is in both top and bottom halves and, when closed and locked, these grooves form a perfectly round hole the exact outside diameter of the tube as it originally was.

A boilermaker's tube roller is the one used, only it is in miniature and made to roll the tubes to the proper inside diameter. With two boys, one at each lathe, the operation is one of extreme simplicity.

Cutting Off

If the tubes are to be used in any but the original condenser from which they were removed, the length in all probability will be different, and they must be shortened.

The rig shown in Fig. 5 is an excellent one for cutting them to the proper length, and I feel is self-explanatory, although a few words may not be amiss. The rig is made with a column *a*, which is bolted to the table of a milling machine. The top of this column is cut out to receive the ends of the steel leaf spring on the end of which is the hinged clamp, which is held open by a small steel-wire spring.

The tubes to be cut are backed against some conveniently arranged stop, and the end to be cut is rolled into the bottom half of the clamp. There, with a downward motion of the handle, the top comes into contact with the tube, securely holding it and bringing it into contact with the saw. The burs are removed with a cutter bar and small cutter, mounted in an air drill, which is held in a vise and the tubes pushed against the cutter.

Testing

To be sure the tubes are perfect they now need to be tested for any leaks, and the testing rig for this purpose is shown in Figs. 1, 2 and 3. In the economical testing of any small parts, such as tubes, etc., speed is the main object and it was with this in view that this rig was designed.

The rig consists of two hollow manifolds of bronze, suitably designed to stand 1000 pounds per square inch hydrostatic pressure. One of these is mounted at the end of any suitable base; heavy wood, say 3x12 inches, or a long piece of boiler plate. The other manifold is to be adjustable along the length of the base, to admit of various length tubes being tested, but it also must be bolted securely to the base.

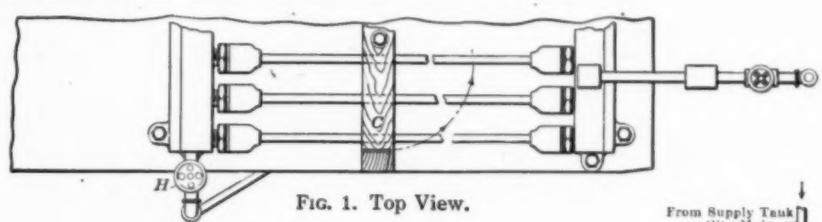


Fig. 1. Top View.

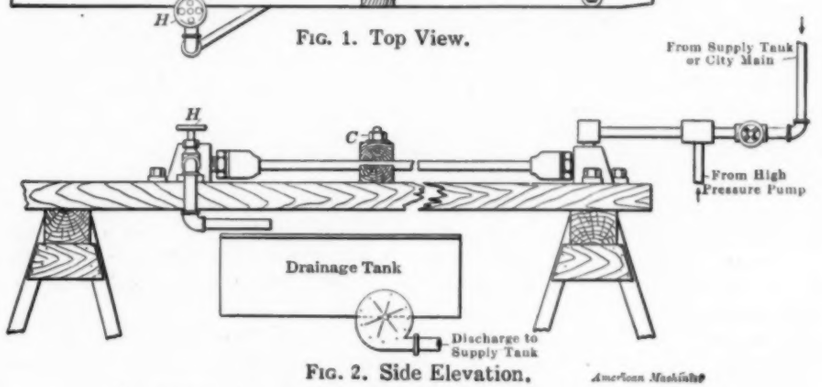


Fig. 2. Side Elevation.

Apparatus for Testing Re-expanded Condenser Tubes

Fig. 3 shows the fittings which hold the tubes and form the water-tight joint. This is made possible by the hydraulic cup leathers. The front end, or mouth of the fitting, is made bell shaped to facilitate the adjusting of the tubes. One fitting is made as per sketch and the one which is to take the opposite end of

the same tube is bored through on the dotted lines *x y*, *x y*.

To place a tube in the rig, simply shove it in through the bell mouth as far as it will go (see dotted lines at extension of tube, Fig. 3). The other end of the tube should now be just clear of the bell-mouthed fitting in the other manifold. Pull back and shove the tube into this fitting until it strikes the shoulder *x x*, and when tubes are in all the fittings you are ready to proceed.

Owing to the tendency of the tubes to buckle, it is necessary to put on a restraining clamp, as shown at *C C*, Figs. 1 and 2. This consists of a piece of timber grooved to let the tubes rest in it,

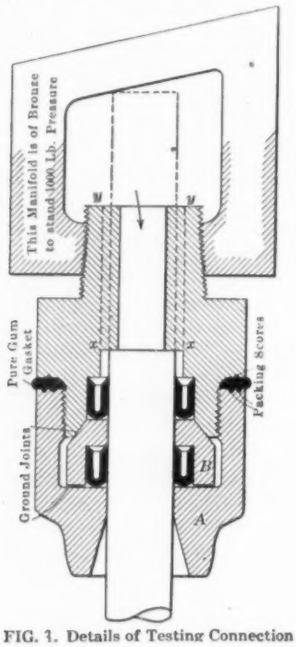


FIG. 1. Details of Testing Connection

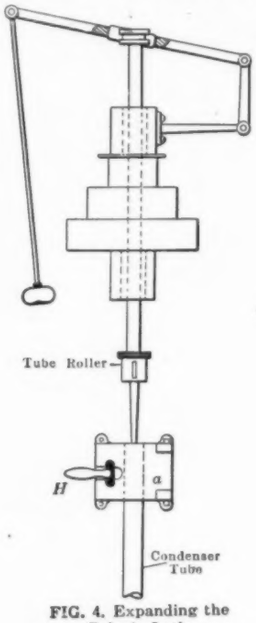
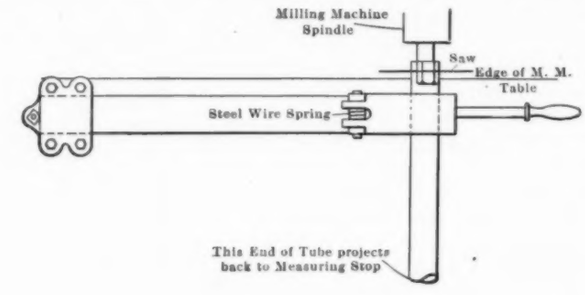


FIG. 4. Expanding the Tube in Lathe



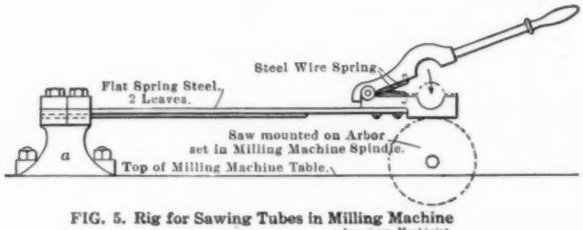

Steel Wire Spring
Flat Spring Steel, 2 Leaves.
Saw mounted on Arbor set in Milling Machine Spindle.
a
Top of Milling Machine Table.

FIG. 5. Rig for Sawing Tubes in Milling Machine
American Machinist

RE-EXPANDING CONDENSER TUBES

and with another timber swiveling on a central bolt to swing over and clamp them down. For long tubes, two or more clamps of this nature may be necessary.

There is no restriction as to the number of bell-mouthed fittings to put in the manifold, as the more fittings the greater economy. By making the parts *A B*, Fig. 3, in one size for ¾-inch tubes, and another set for ⅝-inch tubes, the same manifolds will serve for the two sizes.

An outfit of this kind is in use here on the Pacific Coast and doing excellent work, saving a great deal of money. I hope someone else may find use for it, as it delivers the goods.

In use, be sure to leave valve *H*, Fig. 2, open until the tubes and manifold are filled with water to the exclusion of all air; then close it.

Taxes on Commercial Travelers Abroad

BY A. J. WOLFE.

In reaching out for foreign markets, manufacturers cannot too frequently send out personal representatives to foreign countries. Particularly when an extended trip is taken by a representative on a foreign mission it happens that, through lack of knowledge of regulations and taxes prevailing in foreign countries, the traveling salesman or representative may find himself in conflict with the authorities of the section in which he happens to be operating.

A brief survey of these regulations and taxes for countries most interesting from the point of view of the American export trade follows:

ARGENTINE REPUBLIC

Commercial travelers, whether selling goods in the Argentine Republic or merely showing samples and soliciting orders, must secure licenses. The cost of these in the city of Buenos Ayres and the national territories, as distinct from the other provinces of the Confederation, is $500 currency per annum. In the principal provinces the following license fees are levied on commercial travelers: Cordoba, $200 per half year; Santa Fé, $400 per annum; Mendoza, $600 per annum; May to December, $500; October to December, $400; Buenos Ayres, $400 per annum.

Samples without commercial value are passed by the Argentine customs without payment of import duty; samples of value are charged with import duty, which is refunded if they are reëxported within six months. ($1 currency = 44 cents.)

BRAZIL

There is no federal tax on commercial travelers as such. In some states, however, they are taxed, while in others they are required to take out a trader's license if they act in that capacity.

Para (state), 300 milreis, annual (rarely exacted.) (Municipal): Para, 365 milreis each visit; Rio de Janeiro (state) none on commercial travelers. One milreis is nominally equal to 54 cents; generally it is worth about 32-34 cents.

In practice, a power of attorney is almost universally necessary for a traveler receiving payment for sales. It must be registered before a notary public, who will furnish copies upon payment of the usual fees.

No duty is leviable on samples of no commercial value. The amount of duty payable on samples of value may be deposited at the custom house after petition to the inspector of customs. The duties on the goods reëxported will be returned. Reëxportation must take place through the port of original importation.

CUBA

There are no special regulations affecting commercial travelers in Cuba, but all persons engaged in industry or commerce are required to take out a license in each of the municipal divisions of the republic to carry on their calling. These licenses are issued free of charge. No special regulations exist in regard to commercial travelers representing more than one firm or principals of firms traveling to take orders or to visit their customer.

It is always advisable that commercial travelers should be provided with documents or powers of attorney in order to accredit their profession if it is necessary to do so. In this connection it may be mentioned that the post office, for

a small fee, issues an identification card, which is useful for this purpose throughout the republic.

Mexico

There are no special regulations in force in any state which only apply to foreign commercial travelers, or which discriminate against foreign commercial travelers to the advantage of native travelers or commercial agents, yet, on the other hand, there is no uniformity in the treatment accorded to foreign and native commercial travelers in the different states of the Mexican federation. In some states there are no regulations affecting commercial travelers, in others they are subject to the payment of state and municipal taxes for their license or permit to trade, amounting to considerable sums, and they are liable to severe pecuniary penalties if they fail to comply with the regulations governing the assessment and payment of these taxes. The practice most prevalent appears to be the imposition on all commercial travelers of a state tax as *"derecho de patente,"* equivalent to a right or a license to trade, which is payable monthly, and is assessed according to a fixed maximum and minimum tariff, the limits varying considerably in the different states.

Panama

A municipal tax of $10 for a license available for one month, is payable by commercial travelers in Panama; this permits them to take orders with or without samples.

Uruguay

Commercial travelers must obtain a license, costing $100 annually, expiring on Dec. 31; the full annual charge must be paid, regardless of the period of the year in which the license is taken out.

Australia

No licenses are required.

New Zealand

An income tax is collected on gross sales. Commercial travelers making sales direct have to pay an annual license similar to the stamp duty paid by any incorporated company doing business in the country.

France

Article 24, of the law of July 15, 1880, which is still in force, stipulates that commercial travelers of foreign nations shall be treated as regards licenses on the same basis as French commercial travelers are treated by these same nations. As French commercial travelers are exempt from any special regulations in the United States, American commercial travelers are accordingly exempt in France.

Germany

American commercial travelers must procure a traveling business permit, *"Wandergewerbeschein."* In many parts of Germany an income tax and a business tax will be exacted.

Russia

Commercial travelers arriving in Russia must obtain for themselves a personal license at a cost of 50 rubles and also, at a further cost of 150 rubles, a trading license for the firms they represent. Having taken out the trading license at a cost of 150 rubles, a firm many send out as many travelers as desired, if each is provided with the personal license costing 50 rubles. The trading license may, moreover, be applied for in the name of the traveler, in which case the personal license would not be necessary.

In addition to these initial payments (150 rubles and 50 rubles) provincial and town dues are charged at the rate of 15 per cent. and 10 per cent., respectively, of the initial crown tax, and also certain local dues, variable in amount, and not everywhere leviable. (1 ruble = about 50 cents.)

Micrometer for Fine Measurement

By C. L. Goodrich*

The accompanying illustration shows a standard 1-inch micrometer with special attachments for convenience in measuring within narrow limits.

*Department foreman, Pratt & Whitney Company.

Most micrometer screws, in even the best of new micrometers are not perfect in lead, are either long or short; however, they are generally free from drunkenness.

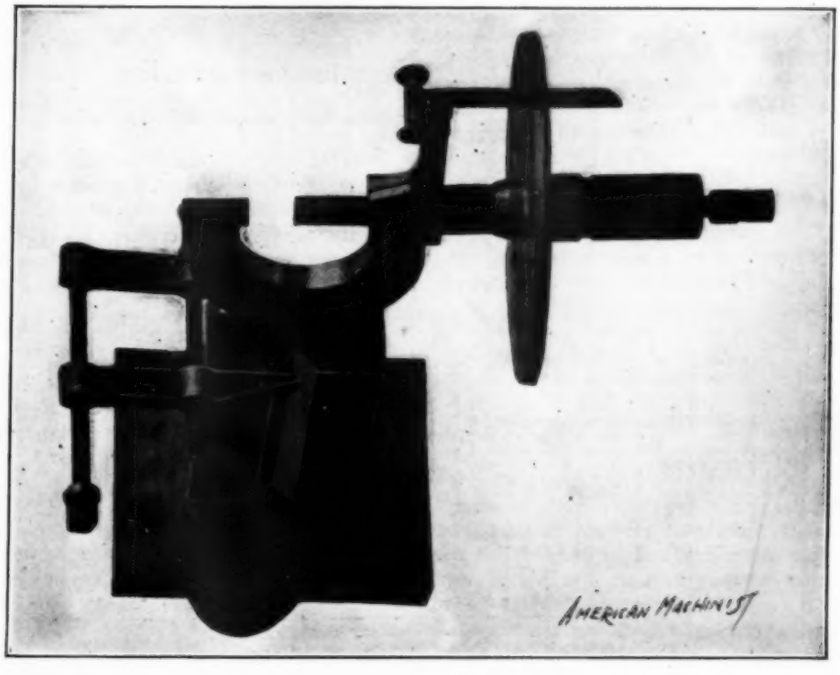
The adjustable arm or pointer shown on this micrometer, provides a means of compensating for the error in the lead, by permitting of angular adjustment in relation to the movement of the sleeve. In effect it amounts to providing a spiral zero line to suit the error in the lead of the screw.

Movement of the arm in one direction compensates for short lead, while reverse movement will make correction for long lead. After the arm is adjusted, it is clamped by the screws shown, and obviously should not be tinkered with.

The large dial which is attached to the adjusting sleeve is about 3 inches in diameter and has 1000 lines graduated upon its periphery. This dial is of aluminum, and is made as light as practicable, to avoid undesirable momentum. Rotation of the sleeve and dial from one line to the next is equivalent to a spindle movement of 1/40,000 inch.

While there is doubt as to the practicability of using the micrometer within such fine limits, it is being used daily on a finer class of work than the standard micrometer is convenient for. On close work the micrometer is clamped in a wooden holder. The ratchet feeler is also made much more sensitive.

In spite of the apparent decreases in the use of bicycles, there is a single shop in central Ohio turning out 500 a day. This looks as though there was a real demand in some parts of the country.



Micrometer for Fine Measurements

Cost Accounting by Machinery

Special Correspondence

How tabulating machines are utilized in the works of a prominent builder of engine lathes, for finding labor costs on entire lots of machines and on groups of parts or on detail parts put through in quantities if desired.

Distribution classifications for distinguishing costs of productive from nonproductive labor; standard from special work; regular-hour from overtime costs.

A system for the stock room by which a record is kept of the amount and costs of materials of various kinds purchased outside the works and delivered to the shop departments on requisition. Perpetual inventory by machinery.

Extension of the system to cover the work of the accounting department.

AMERICAN MACHINIST readers are already familiar with the principles of the accounting apparatus built by the Tabulating Machine Company, Washington, D. C. Some interesting applications of this system have been made at the plant of the Lodge & Shipley Machine Tool Company, Cincinnati, O., and a few of the cards and time forms utilized in conjunction with the tabulating machines are represented by the accompanying engravings.

The tabulating equipment as used at this plant consists of an automatic card sorter, a tabulating machine, a gang punch (or dater) and three hand punches.

THE TIME SHEET

The data for this method of accounting are, of course, derived primarily from the time sheets, which are filled out by the time clerk from the shop-work slips of the different employees. One of these time sheets is illustrated in Fig. 1, and, as will be noticed, it is adapted to receive the record of one workman for a week, the week in this case commencing with Friday morning and ending the following Thursday night.

The column heading "Dept." refers to the lathe, planer, milling or other department, which in each case is known by number, the lathe department being known as Dept. 1. The shop number of the job, 2014, is placed in the next column and the number by which the given piece of work is always designated is given under "Piece No." as 655. Under the heading "Group No." is placed the number 11, which is the designation of the particular group to which piece 655 belongs. A piece, for example, may be a gear in the change-gear group, or a member of the apron mechanism; in any case the number of the group in which it is included is indicated in the proper column.

OPERATION NUMBERS, SYMBOLS, ETC.

Each operation upon any picee of work is designated by a number and the column for operation numbers is followed by one for machine numbers, each machine in the shop having a number by which it is identified upon the records.

On the time-sheet operation, No. 107 is recorded as performed upon machine tool No. 650. The column headed "Sym." gives the symbol by which the particular size of lathe being built is designated. In the case represented, it shows from the shop number, 2014, that a lot of 20-inch lathes are going through the shop, and the corresponding symbol for that size of machine is the letter E. The column for the name of the operation shows that operation No. 107 is really a combined turning and facing operation.

The succeeding columns give the number of pieces, the time when the job is started, the hours spent upon it each day and the total hours and amount charged to the job for the week.

THE TABULATING CARDS

In Fig. 2 the tabulating card for labor costs is reproduced about ⅔ actual size. It is represented as punched to correspond to the data given on the time sheet, Fig. 1. These records, by the way, are punched by the operator at the rate of about 600 per hour. The card is light yellow in color. The first three columns at the left indicate the month, week and day, the four figures over the day column being the numbers of the operators in the cost department who manipulate the punching machines. These cards are used so extensively that they are ordered in lots of 100,000, which represent possibly three months' supply.

Following this card from left to right, it will be found that the punched openings read: Dept. 11; Man 128; Charge [shop No.] 2014; Piece No. 655; Group No. 11; Operation 107; Machine 650; Hours 55; Amount 16.50.

In the first subdivision of the "charge" field will be seen a column of distribution classification abbreviations as follows: "Std.," standard; "Rep.," repair [repair work done on machines for outside parties]; "Tls.," tools; "N. Pt.," new patterns; "A. Pt.," altered patterns; "Drw.," drawing; "M. M.," maintenance of machinery; "ShX.," shop expense [labor handling castings about the shop, sweeping, oiling, etc.], "CmX.," commercial expense [includes salaries, traveling expenses, etc.].

TIME SHEET Ck. No. 128

NAME John Doe OPERATING Engine Lathe

Prem.	Dept.	Shop No.	Pc. No.	Group No.	Oper. No.	Mch. No.	Sym.	Name Operation	Amt. in Pcs.	Time Start	F	S	M	T	W	T	Hours Charged to Job	Amt. Charged to Job	Remarks	Fmn.
	1	2014	655	11	107	650	E	Turn and face	100	6.45	10	5	10	10	10	10	55.00	16.50		
								Totals									55.90	16.50		

EXAMINED J. C. D. TIMEKEEPER WEEK ENDED 12-3-10

FIG. 1. TIME SHEET (ACTUAL SIZE 9x12 INCHES).

A classification column of different character is provided at the extreme right of the card where the abbreviations and their meanings are as follows: "R. H.," regular hours; "O. H.," overtime hours; "Prm.," premium; "Pro.," productive; "RSp.," replacing spoiled work; "RDf.," replacing defective material; "NP.," nonproductive.

System of Grouping

The foregoing shows the classifications by which the cards may be sorted and tabulated. To check the cards with the time-clock records and pay roll, the cards for the entire week are run through the adding machine at the end of each week, and made to balance with the clock hours and pay-roll amount. In sorting by the distribution column the cards are run through the automatic sorter in the classification column to group those for the standard jobs, repair work, etc.; then these standard work cards, say, are resorted and grouped by charge numbers or shop numbers are filed away in the racks until the jobs recorded are completed, when the cards for each job are all run through the tabulating machine to get the total labor cost on that particular charge number.

Similarly, cards may be sorted and grouped for repair work, and when completed the total labor cost is arrived at by passing all the cards through the tabulator.

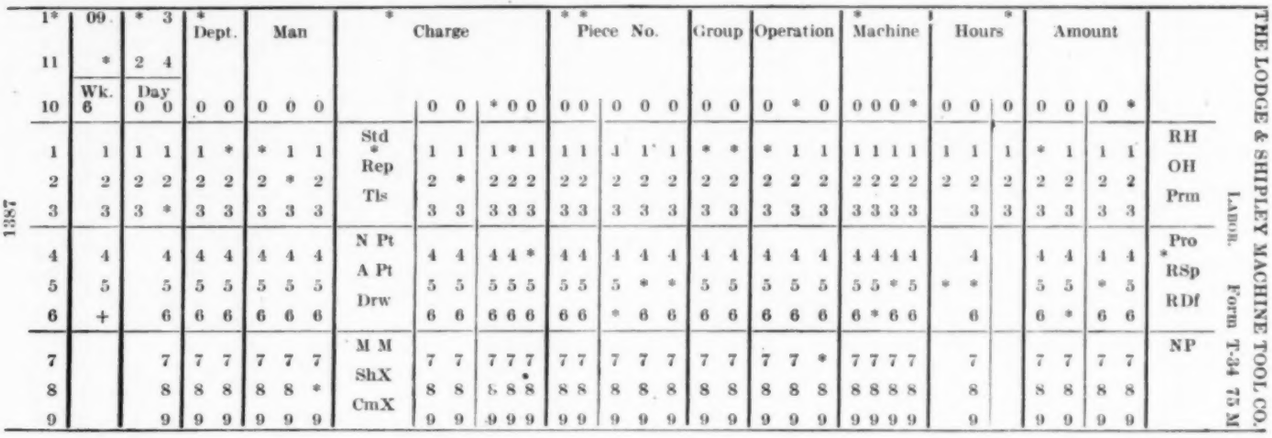


Fig. 2. Punched Card for Labor Costs

Other Classifications

This distribution classification column also makes it possible to sort and group the cards to find the total labor cost of such items as patterns, drawings or tools required on the work.

After the shop has completed the machines in, for example, lot No. 2014 (which is referred to on the time sheet, Fig. 1), the cards are sorted and grouped by piece numbers, and the tabulating machine then gives the total labor cost on the entire lot of lathes, or on separate groups or pieces. From the different fields punched it is obviously an easy matter to secure labor costs of separate operations on any lot of work, or costs by group numbers, if desired. The machine field can be used if desired for obtaining the burden on machine hours.

The column of classifications at the right-hand end of the cards permits them to be sorted and grouped for the purpose of determining costs of productive and nonproductive labor; costs of replacing defective material; costs of overtime, etc. In the case of nonproductive items these are gotten out by sorting every week, the totals being added for the month and turned in to the auditing department.

Stock-room Records

The cards in Figs. 3 and 4 are for the perpetual inventory of rough material and completed parts purchased outside the works, the tabulating machine totaling the number of pieces, quantity and amount, as punched in the last three fields respectively. The card, Fig. 3, for materials purchased is green; the card for materials delivered to the shop from the stock room is bright red. As stock purchased is received, the green cards are punched as in Fig. 3 for the piece number, if it is a machine part, the number of pieces and the price. If bar material and other stock is bought by weight or by measure, the cards are punched in the "Unit" and "Quantity" fields. It is naturally impossible in many cases

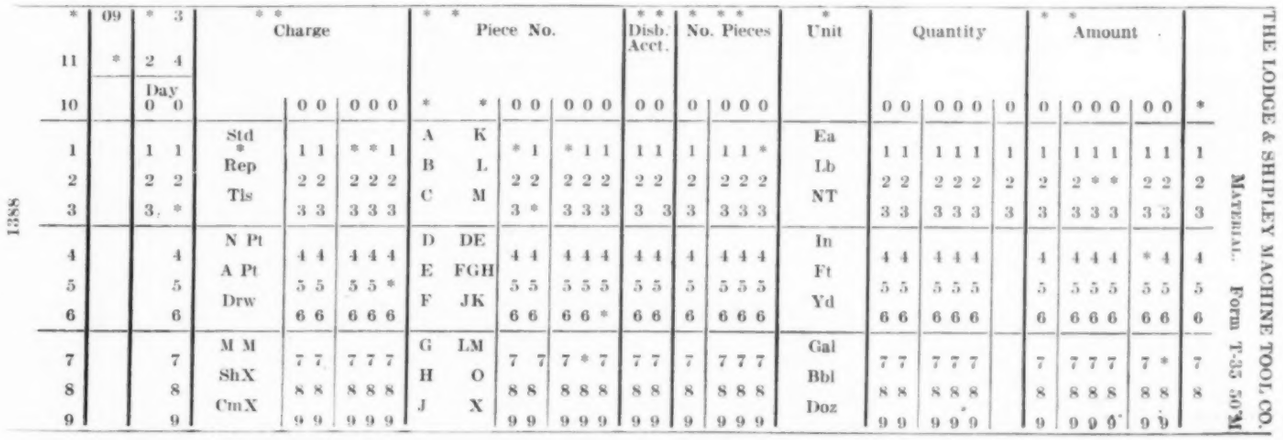


Fig. 3. Card for Material Received in Stock Room

to punch the "Charge" field, as it usually is not known when material is purchased just what shop number will be assigned to the work to be made up from that batch of material. The classification column at the extreme right is punched to show the nature of the material, thus: 1—cast iron; 2—steel casting; 3—bronze; 4—drop forging; 5—cut to length; 6—barstock; 7—bronze tubing; 8—racks; 9—screws and nuts; 0—miscellaneous. A similar classification column is provided on the red card Fig. 4.

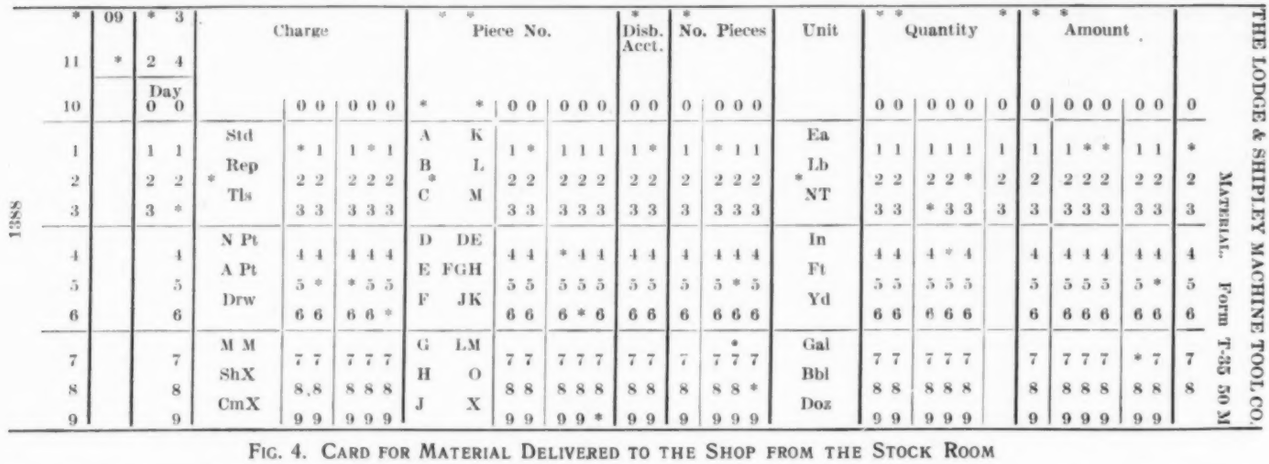


FIG. 4. CARD FOR MATERIAL DELIVERED TO THE SHOP FROM THE STOCK ROOM

In the case of the green card shown in Fig. 3, the punched holes show that one piece, known as No. 13,176, has been purchased at a cost of $22.47, which is charged to shop No. 115. There is a distribution classification in the "Charge" field, similar to that on the labor card, Fig. 1, and in the field for "Piece Numbers," a classification column of letters representing different sizes of lathes built. In some instances two or more letters are used in conjunction, indicating that certain parts are alike on two or more sizes of lathes. Thus, the letters "F G H," representing the 22-, 24- and 27-inch lathes, are placed in combination in addition to being arranged separately in another column, as there are certain parts exactly alike on these three sizes of lathes, which are known by the same piece number, whether for 22-, 24- or 27-inch swing machines.

MATERIAL WITHDRAWN FROM STOCK

Besides the distribution columns on the cards, already referred to, there is a column at the middle, which, in the case of the red card, is used for the following classification: 1—Goods in process; 2—Shop supplies (files, emery cloth, etc.); 3—Jigs and tools; 4—Machine maintenance; 5—Shipping supplies; 6—Shop fixtures; 7—Sales to employees; 8—Obsolete material and profit and loss; 9—Pattern supplies.

The shop departments obtain material from the stock room upon requisition, and the stock clerk sends these requisitions to the cost-keeping department each day, showing just what material has been delivered to the shop, and the red cards are punched accordingly each day, filed away until the end of the month, then sorted and tabulated. The material cost on any given lot or piece can be readily determined by sorting the red cards, according to shop number or piece number.

The monthly grouping and tabulation of the cards shows the amount and the cost of material of various kinds delivered to the shop from the store room during that period, and as the green cards show just what material has been received during that time, the stock clerk can easily keep a record of material on hand. The stock record, as kept by these tabulating-machine cards, is checked up by the regular inventory taken annually.

APPLICATION TO ACCOUNTING DEPARTMENT

The latest development in connection with the system at this plant, is its extension to the accounting department where it makes a further distribution of expenses which heretofore were arranged by columns on analysis sheets under the classifications, "Manufacturing," "Selling" and "Commercial," and included a total of about sixty distributions, which was about all that could be conveniently handled under this method. With the present card system they have about three hundred and these represent the total expenditures exclusive of material (used in construction of machines) productive labor and investment. Only one card form in two colors is used, yellow for credit and red for debit. In addition to the above are incorporated commodity and quantity columns covering total purchases.

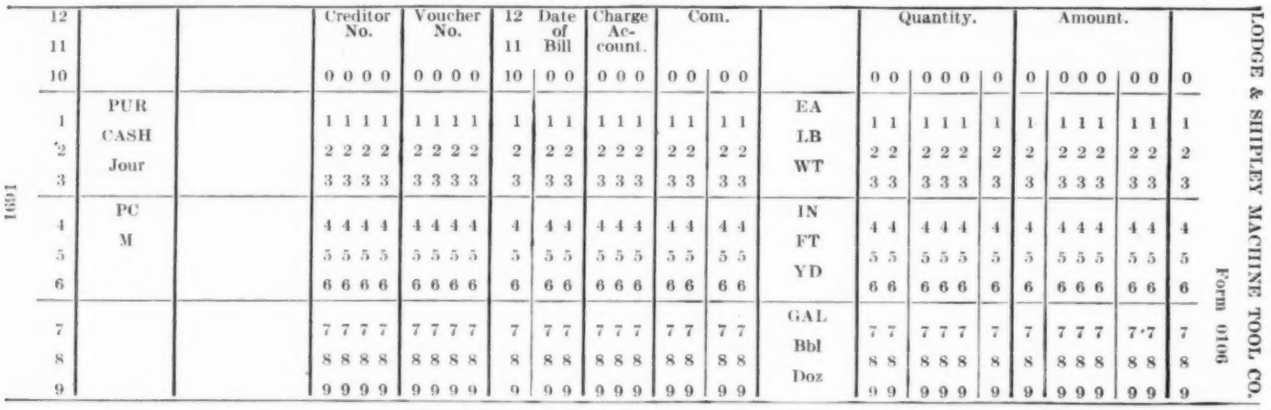


FIG. 5. CARD FOR ACCOUNTING DEPARTMENT

THE CARD FOR ACCOUNTING DEPARTMENT

Fig. 5 represents the card with fields for complete data. Starting at the ex-

treme left of the card the numbers 1 to 12 are shown for the months in the year under which the current vouchers and bills for the month are bound or filed. The next column gives the classification of voucher or entry. "Pur." for purchase, "Cash;" "Jour," Journal; "P. C." Petty Cash; and "M," Miscellaneous. The next field, blank, is not used. Credit No. gives the account number, which remains constant and in connection with which is used a division card index on the reverse of which are recorded the voucher numbers in sequence by automatic numbering machine. The headings "Voucher No." and date of bill explain themselves.

The field headed "Charge Account" is for subdivision of expenses which are assigned numbers as follows: Manufacturing Expenses, Nos. 1 to 199 inclusive; Selling, 200 to 299; Commercial, 300 to 399; Nos. 400 to 599 are reserved for Store Room, and Goods in Process, in the event of its being decided later on to include these in the cost-accounting system.

THE LODGE & SHIPLEY MACHINE TOOL CO.

MANUFACTURING EXPENSES.

Form o. Date.....19..

			Current Month.	Months to Date.
64	**Patterns**			
65	Aluminum			
66	Labor			
67	Lumber			
68	Paints			
69	Supplies			
70	Misc			
71	**Porters—Labor**			
72	**Power & Light**			
73	Engineer & Firemen			
74	Electricians			
75	Fuel			
76	Light			
77	Supplies			
78	**Purchasing Dept.**			
79	Staty. & Prtg. Forms			
80	Supplies			
81	Wages			
82	**Rent**			
83	**Small Tools**			
84	Dies & Stocks			
85	Drills & Counterbores			
86	Figures & Letters			
87	Gear Cutters			
88	Gauges, Levels & Micr			
89	Key Way Cutters			
90	Lathe Dogs			
91	Milling Cutters			

FIG. 6. PORTION OF RECORD SHEET FOR MANUFACTURING EXPENSES. ACTUAL SIZE 8½x14 INCHES

AIDING THE PURCHASING DEPARTMENT

The following fields to the "Amount" column are for the Commodity and Quantity and have no connection with Accounting Department records, being embodied in the card for the benefit of the Purchasing Department. Nos. 600 to 699 are allotted for this purpose and represent the total purchases. Nos. 1 to 400 above merely include expense items. The divisions for the Purchasing Department are classified under such commodities as would interest the purchasing agent and used by him as a guide in contracting for or ordering such quantities of material as he would deem advisable or necessary for the proper conduct of the business. All bills are passed to the Accounting Department as soon as the material has been received or found correct, and on them is noted in the space reserved on the rubber receiving stamp, the distribution or "Charge Account" number and "Commodity" number. The data are now complete for the punching of the cards, with the exception of the "Creditor No.," which is obtained from the card index.

CLASSIFICATION OF VOUCHERS

This work completed, the bills are then filed for vouchering, when all bills for material received for the month are passed. The vouchers are then numbered consecutively and entered in the Purchase Journal which is arranged in columns with headings for classifications as follows: Capital Accounts—Plant, Machy., Fixtures, etc.; Stock Accounts—Storeroom, Goods in Process;—Expense Accounts—Mfg., Selling and Commercial; and sundry accounts for direct postings to ledger account for personal accounts, etc. Control accounts are therefore obtained by footings of these various columns. The subdivisions on the cards are then grouped and totaled on the machines and the summaries proved. The cards are then ready to be run through the machine and assorted in consecutive order according to their charge account number, each account is separately footed on the machine and the amounts are transcribed on sheets numerically arranged with the classifications printed opposite the number. A section of one of these sheets is shown in Fig. 6.

ARRANGEMENT OF EXPENSE SHEETS

These sheets are divided into four classifications, under the headings: Manufacturing Expenses; Selling Expenses; Commercial Expenses; Purchases. The sheets are perforated for filing in a binder and become a permanent record.

With the data contained on the cards as applied in this system it is possible with the aid of the machine, to obtain any information desired, such as the total purchases from any party for any given period, the nature of the purchases; quantity by weight; amount in feet, and inches; etc.

A New Method of Tinning and Galvanizing

BY M. E. HOAG

The Watrous Manufacturing Co., of Des Moines, Iowa, is using a method for galvanizing and tinning that is both new and interesting, as compared with former methods.

By the old process of hand dipping, one, or at best, but a very few parts could be operated on at a time, and it also left a fin or drip, besides giving the parts a much heavier coating of metal than was necessary. On such work as chains, hinges, etc., it also soldered the parts together and they had to be broken apart by hand.

By the Watrous method the parts are given a thin and even coating of metal, and small parts, which are put through in large quantities, come out clean, and free from drip, or fins.

The work is pickled and washed as in the old process, and is then put into square metal baskets which hold about 100 pounds depending on the size and shape of the parts. The loaded basket is then dipped into a tank of the melted metal and allowed to soak until well heated throughout, it is then quickly lifted out and dropped into a cage which is set in rapid rotation by a suitable transmission under the floor. This throws off all superflous metal and agitates the parts in such a manner that they come from the basket free.

Two operators can handle several thousand pounds of parts in a day, and one machine will take care of the work from 3 or 4 furnaces as the cage is kept in motion but 8 or 10 seconds, and it requires several minutes to heat a basket of parts.

A short time ago an experiment was carried out on a carload of steel nails, which resulted in a surplus of less than one half that obtained by the old methods. This process and the machines used are covered by patents.

Deodorizing half a million gallons of sewage a day, killing all germs and leaving a clear liquid carrying only a trifling sediment of iron salts, Santa Monica, Cal., claims to have solved all sewage problems that confronts all cities.

Live Tailstock Centers, Electric Hardening and Some Other Things

By W. D. Forbes*

I made some remarks concerning the dead center of a lathe, so made that it would partake of the motion of the piece being turned, in one of my previous contributions to the American Machinist. Several letters on the subject have been received by me, also a model.

The main value of any arrangement of this kind lies in the fact that it relieves the thrust when high-speed tool steel is used and a heavy cut taken; little trouble is found in light cuts we all know, but from the letters received and sample sent no one seems really to have anything which looks to me thoroughly practical, but it is evident that something of this kind is needed in heavy work.

My own idea would be to have the fit of the taper in the tailstock a running one, and at the small end supply a ball thrust. Of course, this would need nice adjustment, but it would have the advantage that, should anything stick, your tailstock center is as good as it was originally. Those who have written to me seem to harp more on the matter of parallelism in the work on these centers than anything else, and it seems to me that this is not at all that which is to be looked for.

The ball-bearing tail center is to relieve the pressures of heavy cuts and not to give great accuracy of work; accuracy of work is to be desired in many cases, but in roughing work accuracy does not count, it is a case of "getting rid of the goods," so to speak.

Electric Hardening

I described a system of hardening on page 157, Volume 33, Part I, and have been trying to get information on this subject and to arrive at some reason why the alternating current, instead of the direct current, cannot be employed in this hardening system.

The original experiments were carried on in a shed, as far as I can ascertain, where the fumes of the hydrocyanic acid would have dissipated easily. The danger, of course, is apparent, and on investigation I now find that a solution of potassium carbonate is used in place of the original cyanide solution. The actual current required seems to be 75 and 100 amperes but, of course, the time required is very short. The theory probably is, that a film of hydrogen gas surrounds the tool which offers great resistance to electric current and consequently produces great heat. The amperage should never be less than 200.

I also find that where this system is used, long tapered reamers are most successfully hardened without any springing. This, of course, is a very decided advantage.

This matter of hardening tools is of great moment. The introduction of high-speed steel has done away with many of our troubles, but I am beginning to think that the question of just how tools are used accounts for many difficulties which have been encountered, due to the edges not holding up. For instance, while watching a Powell planer in Fitchburg, Mass., I saw an ordinary carbon tool stand work that I would not have believed possible with any high-speed steel. Over 90 feet a minute was being cut, and the tool held its edge perfectly. The peculiar system employed by Mr. Powell accounted for it, at least, to a certain extent, and the method was, to have the tool enter the work for a short distance, say for an inch, at 18 or 20 feet a minute, then the speed was increased to the speed above stated and the tool stripped off a piece of metal that actually glowed. This performance was not "hippodroming," the planer was doing everyday work. Now, here was a tool of ordinary quality standing up, in a way that absolutely astonished me, and the only way I could account for it was the fact of the slow entering and then augmented speed, but still why should we not be able to do far better with a lathe tool, than has been done on the same principle? As far as I know, there is no lathe which would augment speed evenly, and my attempts to work out something along these lines have invariably failed to work out.

The entire question of mechanical consideration turns on this point of removing metal. It must be removed so that what is left can be sold for more than it cost; to provide the material, do the work, and pay overhead costs little can be saved in the material, unproductive labor has to be employed at living wages and here an attempt at saving is often made, to the detriment of the enterprise, instead of bettering it, so it really comes down to cheaper production in the works.

Common Shop Questions

We all know the talk and sarcasm indulged in at times by those who operate shops from the office, to the effect that work done outside is always cheaper and better than what is done in the shop.

We all know that certain things can be turned out cheaper by other institutions than our own, but there is a reason for it. No one expects to make a set screw as cheaply as it could be bought. The number produced accounts for this fact, and again, we all buy our pulleys and many other things which are made more cheaply than we can produce them, for the reason that special tools and facilities are provided for the special work and this, coupled with the number of practically the same articles, must result in cheaper products.

The question of good cutting tools is of great moment, as I have intimated, but it is far more important to get something to cut, the more there is to cut, the cheaper it can be done. Under the condition of a full shop and lots of work in sight, the output comes up without any effort on the part of the management; the men "hump" themselves.

Now, this accounts largely for cheaper work in stock articles. The automatic machine can be produced to its last capacity, and its product being staple, its customers are not in any one particular line of machine work; the profit on these staple articles is not large, but no one ever goes "broke" taking small products.

What I am aiming at, however, is how can we produce more for the wages paid for work which is only semi-standard? That is to say, work which amounts to a completed article made up largely of standard parts, such as set screws, pulleys, gears, etc., but assembled, such as a steam engine or printing press.

My answer is, first get more of the work to do, that is the main thing. If you have all you can do and the outlook is good, devise certain appliances, tools and fixtures, but even without doing any of these things, work can be greatly cheapened if the men directly in charge of the mechanical work are not called upon to do anything else but to look after it. They are not to be asked to remember if "that No. 6 machine didn't have a special shaft," or to go up in the loft and hunt for a core box, or add up a lot of odd fractional figures on a blueprint in order to get the overall length for some piece, or check up incoming castings, for all these latter things tend to increase the cost of work, when most of them should be matters of record or to be looked after by properly designated parties.

The mere fact of being always "on the job," seeing that tools are provided and are in proper shape and are properly returned and in good order, effect the saving, which few appreciate.

According to the *Brass World* a patent was recently issued covering an alloy of magnesium and zinc, which, it is claimed, is especially suitable for air-ship and similar construction. The use of a small quantity of zinc greatly strengthens the magnesium, both for casting and for rolling sheet, and a mixture advocated is 96 per cent. magnesium and 4 per cent. zinc. The alloy may be made by first melting the magnesium in an iron crucible provided with a well fitting cover. When melted, the zinc is added and the whole stirred. The melting of the magnesium must take place with the exclusion of air. It is stated by the inventor that the fracture of the rolled alloy has a fine structure like that of steel. It can be rolled or cast and machined without difficulty.

*President, W. D. Forbes Company, New London, Conn.

Four Belgian Machine Tools

Features of design in four standard tools with a table of speeds and feeds for upright drills.

One of the most important builders of heavy machine tools in Belgium is the Société Anonyme de Constructions Mécaniques de Longdoz, at Liège. Four machines built by this firm are illustrated in this article; namely, a 10-foot boring mill, a locomotive driving wheel turning lathe, a planer, and an upright drill.

Horizontal Boring Mill

The boring mill illustrated in Fig. 1 has a table diameter of 100 inches, a capacity in diameter of 120 inches, with a corresponding hight of 64 inches, a movement of tool bar of 36 inches, and a net weight of about 68,000 pounds. As shown, it is motor driven, with a motor having a capacity of 16 to 18 horsepower and variable speeds with a ratio of 1 to 2.5. Motors having a speed ratio of 1 to 3 are furnished if desired.

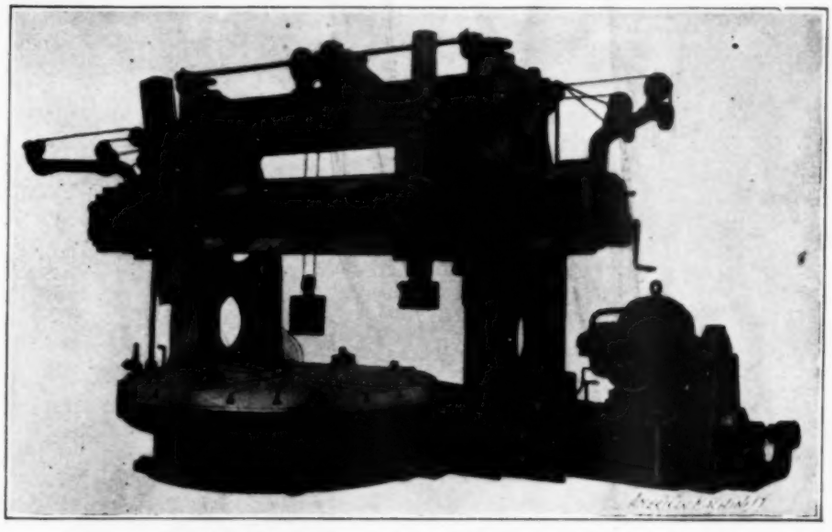


Fig. 1. Belgian 10-ft. Boring Mill

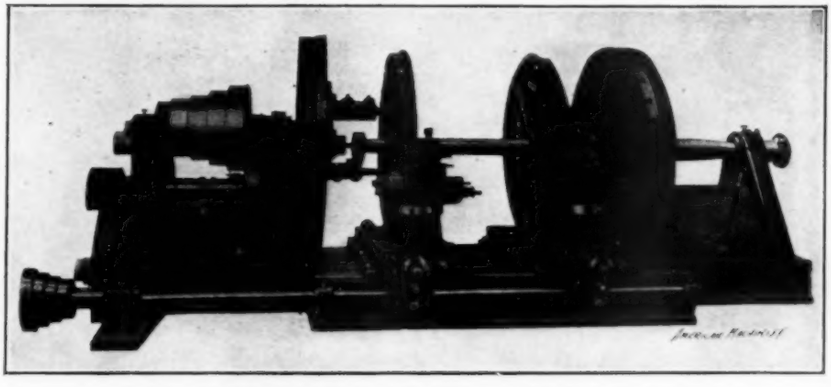


Fig. 2. Belgian Locomotive-driving Wheel Lathe

The machine may also be arranged for belt driving, in which case the gear on the friction clutch is replaced by a constant-speed pulley.

With this belt drive and with a constant-speed pulley a five-speed change gear box is provided. This gear box, in combination with two sets of back gears, gives a range of 15 different table speeds. These speeds vary from about 0.45 to 10.5 revolutions per minute.

A friction clutch in connection with either the constant-speed pulley or a gear in the motor drive, permits of stopping the machine without stopping the driving pulley or motor, as the case may be.

When the table is rotated at the high speed it can be raised slightly in order to avoid excessive friction on the guiding track. The table gear is a crown, driven by a gear of comparatively large diameter, which is believed to sensibly lessen the injurious effect of the obliquity of beveled pinion teeth.

The cross rail is of a heavy section as shown and is guided both on the front and on the back of the bearing surface on the housings. This is to insure the rigidity of the rail when subjected to torsional forces.

Two saddles are provided, each carrying a tool bar that can be inclined to any angle desired within its range; each being completely independent of the other and having both automatic and hand feeds in horizontal, vertical and inclined directions.

The vertical motion of the cross rail is by means of a small auxiliary motor in case the tool is motor driven, or from a countershaft with a set of three pulleys in case the main drive is from the constant-speed pulley.

The position of the cords, or ropes, connecting the counter weights and tool bars, are so arranged that the front of the cross rail is unobstructed, permitting the saddles to be brought close together and thus facilitating the mounting and removing of work.

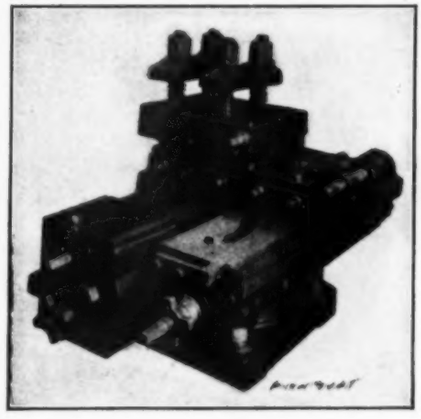


Fig. 3. Templet Attached for Lathe Rest

The feeds per turn of the table either in a horizontal, vertical, or inclined direction, are as follows, expressed in millimeters, 0.375, 0.5, 0.625, 0.750, 1, 1.25, 2, 2.5, 3, 4, 5, 6, 8, 10 and 12. These permit of thread cutting to the corresponding metric pitches.

Lubrication is from a single station on the inside of the left-hand housing, as seen in the illustration. A sight-feed oil cup feeds oil into a horizontal header, from which a system of pipes convey the oil to all of the bearings. The table track is lubricated by rolls carried in oil

pockets, the level of the oil being shown by an indicator on the outside.

Locomotive Wheel-turning Lathe

This lathe is illustrated in Fig. 2 and a templet attachment for turning the profile of tread and flange is shown in Fig. 3. The faceplates are 88 inches in diameter, the maximum distance between faceplates is 120 inches, the total length of the bed 272 inches, and the net weight upward of 60,000 pounds. It is of heavy construction, is intended for severe service, and is provided with two automatic profiling rests, using one templet to finish the complete profile of two wheels.

capacity is provided. This lathe is usually equipped with two double tool rests at the rear, arranged to machine simultaneously the sides of the wheel.

The templet-turning attachment can be plainly seen in Fig. 3. By means of this rest the complete tire outline is automatically produced. The tool used is the usual half-round profiling tool, and the templet has a motion of translation opposite to the motion of the tool and at double the rate; that is to say, while the tool travels in the direction of the feed one inch, the templet is displaced in the other direction two inches. From this fact it will be seen that the length of the templet being equal to the sum of the paths traveled by the tool and the templet itself, will be equal to three times the tire width. This gives a contour to the templet which can be followed by the controlling roll with comparative ease. It has been possible to use a speed as high as two millimeters (0.08 inch) per revolution and in tests a profiling cut on wheels one meter (3.4 feet) in diameter has been taken in 20 minutes, the rate of faceplate speed being five revolutions per minute.

The operating mechanism in this rest is plainly shown by Fig. 3.

The templets themselves are laid off from the machine, in which is mounted a gage representing a section of the tire for which the templet is to be used. The cutting tool is replaced by a roll having a radius equal to the radius of the cutting edge of the tool. The guide roller which enters the templet is replaced by a milling cutter or by a scriber, arranged to trace circles of the same diameter as the templet roll.

The roll that replaces the cutting tool is successively brought into a number of positions along the surface of the tire gage and at each setting a circle is traced on the templet blank, indicating the corresponding position of the templet roller. The profile given by these circles is the profile of the templet desired.

These templets are made from a hard grade of steel and are not hardened.

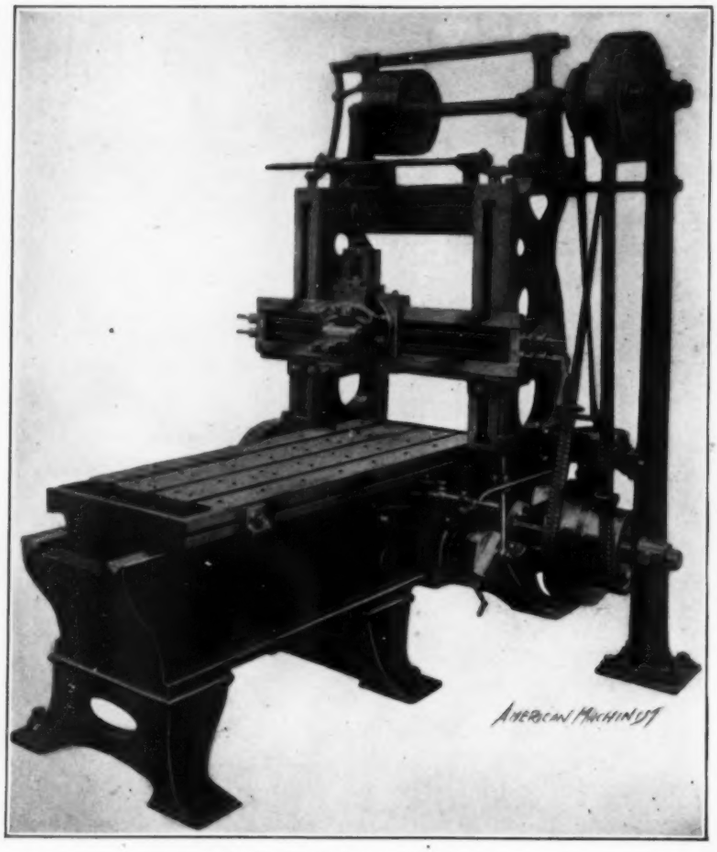


Fig. 4. Belgian Planer

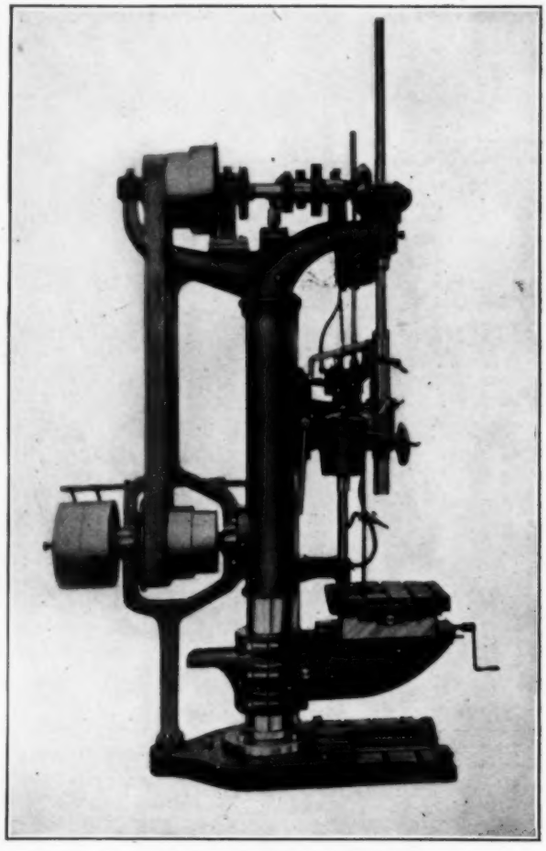


Fig. 5. Belgian Upright Drill

The drive is from a two-speed countershaft upon a four-step cone, with double back gears, giving 16 different faceplate speeds, ranging approximately from 0.7 to 5 revolutions per minute.

The pinions meshing with the faceplate gears are adjustable and so arranged that the faceplates can be driven together for the profiling operation, or either faceplate can be driven independent of the other when used for faceplate work.

There are two ranges of feeds, the one from 0.66 to 2 millimeters per revolution for faceplate work, the other ranging from 0.33 to 1 millimeter per revolution for tire turning.

When motor drive is desired, an electric motor of from 18 to 20 horsepower

A 24x24 Inch x 4-foot Planer

Fig. 4 shows a metal planer of the size indicated in the column heading above. It is rack driven and has a quick return in the ratio of 1:3. It has V-ways automatically lubricated by rolls. It is belt driven as shown, and the cross rail is only moved vertically by hand.

Perhaps the only striking feature of design is the countershaft, which is carried on two brackets, bolted to the top of the housings and set back of the arch. Between these two brackets, each of which provides a bearing for the countershaft, is a constant-speed pulley driven

Drill Diameter.		Drill Speed—R.P.M.									R.P.M. for Circumferential Speeds of Feet per Minute.						Drill Speed—R.P.M.									Drill Diameter.	
											19	29	39	49	58	68										
Inches.	Mm.	267	200	150	124	93	69	54	41	30.6	Meters per Minute.						243	189	147	111	86.4	67.2	50.3	39.1	30.4	Mm.	Inches.
0.4	15	0.41 110	0.41 82	0.41 61	0.41 50	...	...	...	.....	.....	128t	192t	256t	320t	384t	448t	0.44 107	0.44 83	0.44 65	.....	.....	.....	.....	.....	.....	15	0.4
0.5	20	0.41 110	0.41 82	0.41 61	0.41 50	0.41 38	...	...	.....	.....	95t	143t	190t	238t	286t	334t	0.44 107	0.44 83	0.44 65	0.44 49	.....	.....	.....	.....	.....	20	0.5
0.6	25	0.41 110	0.41 82	0.41 61	0.41 50	0.41 38	...	...	.....	.....	76t	114t	152t	191t	228t	268t	0.44 107	0.44 83	0.44 65	0.44 49	0.44 38	.....	.....	.....	.....	25	0.6
0.75	30	....	0.41 82	0.41 61	0.41 50	0.41 38	0.41 28	...	.....	.....	64t	96t	128t	160t	192t	224t	....	0.44 83	0.44 65	0.44 49	0.44 36	0.44 29	.....	.....	.....	30	0.75
0.9	35	....	0.41 82	0.41 61	0.41 50	0.41 38	0.41 28	0.41 22.5	.....	.....	54t	82t	108t	136t	164t	190t	....	0.44 83	0.44 65	0.44 49	0.44 38	0.44 29	0.44 22	.....	.....	35	0.9
1	40	....	...	0.41 61	0.41 50	0.41 38	0.41 28	0.41 22.5	.....	.....	48t	72t	95t	119t	143t	167t	.....	.....	0.44 65	0.44 49	0.44 38	0.44 29	0.44 22	.....	.....	40	1
1.1	45	....	...	0.30 45	0.41 50	0.41 38	0.41 28	0.41 22.5	0.41 17	.....	43t	64t	85t	106t	127t	148t	....	.....	0.41 65	0.44 49	0.44 38	0.44 29	0.44 22	.....	.....	45	1.1
1.25	50	....	...	...	0.41 50	0.41 38	0.41 28	0.41 22.5	0.41 17	.....	38t	57t	76t	95t	114t	134t	....	.....	.....	0.44 49	0.44 38	0.44 29	0.44 22	0.44 17	.....	50	1.25
1.4	55	....	...	...	0.30 37	0.41 38	0.41 28	0.41 22.5	0.41 17	.....	35t	52t	69t	87t	104t	121t	.....	.....	.....	0.44 49	0.44 38	0.44 29	0.44 22	0.44 17	.....	55	1.4
1.5	60	....	...	...	...	0.30 28	0.41 28	0.41 22.5	0.41 17	0.41 12.5	32t	48t	64t	80t	96t	112t	.....	.....	.....	0.44 49	0.44 38	0.44 29	0.44 22	0.44 17	0.44 13.4	60	1.5
											29t	44t	59t	73t	88t	103t	....	.....	.....	.....	0.44 38	0.44 29	0.44 22	0.44 17	0.44 13.4	65	1.6
											27t	41t	54t	68t	82t	95t	....	.....	.....	.....	0.31 27	0.44 29	0.44 22	0.44 17	0.44 13.4	70	1.75
											25t	38t	51t	64t	76t	89t	....	.....	.....	.....	0.31 27	0.31 21	0.44 22	0.44 17	0.44 13.4	75	1.8
											24t	36t	48t	60t	72t	84t	....	.....	.....	.....	0.31 27	0.31 21	0.44 22	0.44 17	0.44 13.4	80	2

The upper number indicates feed per revolution in millimeters and lower number depth drilled per minute in millimeters.

For Smaller Drill. For Larger Drill.

DRILL SPEED AND FEED TABLE FOR BELGIAN UPRIGHT DRILLS.

from the main line. A long column extending upward from the floor furnishes an outboard bearing for this countershaft, as well as providing a bearing for the outer end of the driving shaft of the machine. The arrangement is so plainly shown in the photograph that further description is unnecessary.

This planer is also built in a larger size, 28x28-inch, by 5-foot bed.

An Upright Drill

Fig. 5 shows us an upright drill of a type that is made in two sizes; the first, or smaller, has table dimensions of 22x22 inches, and the second a table 28x32 inches. In the former the maximum diameter that can be drilled is 2.4 inches; in the latter 3.2 inches. Both tools have been especially designed to use high-speed steel drills. The spindle is carried in a sliding head, as shown, and is rack fed. The work table is slotted and is provided with longitudinal and transverse feed by hand to facilitate setting the work. The arm carrying this table is adjustable vertically and can be swung to either side in order to clear the face-plate of the drill, which is provided with tee slots and also with a large central opening, by means of which very long work can be drilled provided the machine is set over a pit or other opening in the floor.

The main drive is from a three-step cone pulley and gears which give two feed ratios to the spindle in addition to the direct drive; as a result of this arrangement the spindle has a range of nine different speeds.

There are eight feeds derived from a gear box seen on the sliding head. This box is controlled by two levers, one of which throws either a faster or slower speed into mesh, and the other selects any one of four gear positions, as desired.

The accompanying table gives feed and speed combinations for these drills.

Jig for Gas Engine Pipe Connections

By John Anderson

In the accompanying sketch is shown a jig for clamping the casting of the exhaust and intake pipes for a gas engine during the machining and drilling of the joint faces and holes.

This casting is for a four-cylinder engine and consists of a main pipe having four outlet or exhaust branches and four intake openings. These intake openings are cast in pairs in the form of a U-fitting and are part of the exhaust-body casting, although they are not connected to the exhaust body or the branches except at the joint flanges. This, I have attempted to indicate by the dotted section in the elevation at Fig. 2, showing the main body or exhaust pipe in section, openings are cast in both sides, to be used as desired, although but one side is required.

There are four screws like *K*, Figs. 1 and 3; two of these screws are shown at one end of the jig, Fig. 1, and one in Fig. 3. The other end has two screws also. One side is fixed and is screwed with a lock nut, as shown. This is the gage or stop screw, while the opposite one is free to screw in or out, to clamp or screw the casting in position. *L* is a forged machine-steel lever having a projecting piece to fit corresponding slots *G* in bushing plate *D*. The end of lever is hinged on pin *M*, and spring *N* snaps and holds index pin in slot *G*. *O* is a stop screw, with lock nut, for the end of the casting.

To chuck the casting, the bushing plate is removed, the casting is secured with

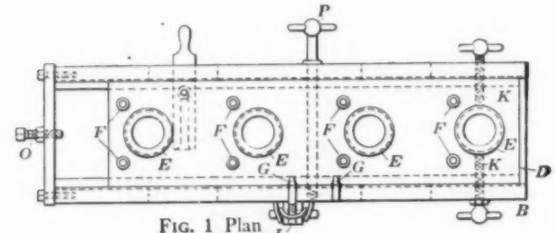


Fig. 1 Plan

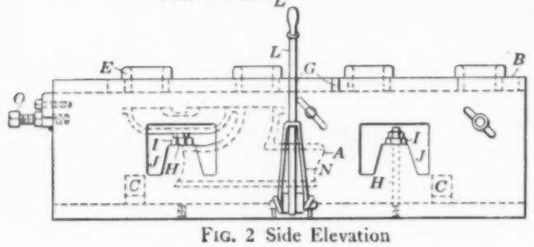


Fig. 2 Side Elevation

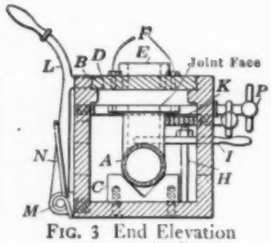


Fig. 3 End Elevation

American Machinist

Jig for Gas-engine Exhaust Connection

one of the four exhaust branches and an intake U-branch, connected at the joint.

It is unnecessary to describe in detail the machining of the casting; it is sufficient to state that the joint which is bolted to the cylinders is counterfaced, the intake and exhaust openings are cleaned up about 5/8 inch deep and the stud holes are drilled.

So as not to confuse, I have omitted some of the detail parts that enter into the construction of the jig, the left clamping screw *K*, for example, as in Fig. 3.

A is a section of the pipe, Figs. 2 and 3. *B* the box jig, cast iron, machined on the outside; at the bottom, inside, to receive the V-blocks *C*; and at the top to receive the bushing plate *D*, which is of cast iron, machined as shown in end elevation, Fig. 3, and drilled to receive the bushings *E E* and *F F F F*, also the index slots *G*. *H* is stud bolt and *I* a strap with which pipe casting is secured in V-blocks while being machined. *J J* are openings in casting *A* to admit the clamping strap *I* and give free access to nut on stud *H*. It also acts as a support for the outer end of clamping strap *I*. These straps *I* and screws *K*; bushing plate *D* is replaced in position, as shown, and clamped with the binding screw *P*. This screw passes through a free hole in one side of *B*, to a tapped hole in the opposite side. The dotted section *A* shows one exhaust branch and the opposite end of intake opening in position for machining, also the holes *F*. By releasing binding screw *P* and index lever *L*, the bushing plate is shifted to the other position or index *G*, which would bring the bushings *E* over the alternate intake ports.

Elastic Rebound in Wire Tension Tests

By H. L. Whittemore

The illustrations show some interesting specimens of wire which have been broken in the testing machine at Watertown, Mass., arsenal. Their appearance is so unusual as to deserve attention and an attempt at explanation.

The single-strand wire, shown in Fig. 1, has been placed so as to show to advantage the several short kinks, just above the arrow, close to the portion held in the grips of the testing machine. The wire was about 1/10 inch in diameter and composed of an alloy of moderate strength. Rupture, when tested in tension, occurred about 3 feet from the face of the grips; but the kinks occurred only in a length of about 9 inches.

It seems probable that the peculiar behavior of these specimens may be explained as follows: The test piece stretched under the tensile stress applied by the testing machine and behaved much like a helical or coil spring. When rupture occurred, it recovered part of the stretch and reduced the tensile stress in the material to zero. If this recovery had taken place slowly, the specimen would have retained that length until again stretched by external forces. In this case, however, the sudden shortening imparted a high velocity to the portion of the wire near the fracture, which would be brought to rest only by the opposition of a compressive stress in the wire near the grips.

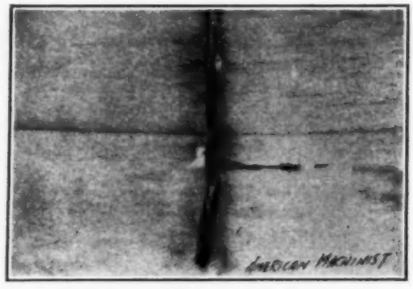


Fig. 1. Kinks in Wire Tension Test Piece Due to Elastic "Rebound"

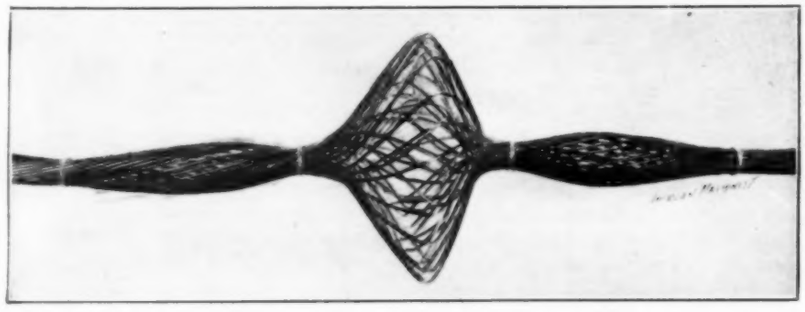


Fig. 2. Effect of "Rebound" in 7/8-inch Wire Cable

Theoretically, a rapid alternation of tensile and compressive stresses would have occurred in the wire with a corresponding retraction and extension of the outer or free end of the specimen. This would much resemble the swing of a pendulum, to which, in fact, it bears a close analogy.

It is apparently the compressive stress in this case which has been great enough to cause the kinks in the wire. As the diameter does not appear to have been increased, the ultimate compressive strength of the material has not been reached. The action is much like that of a long column which, when loaded to its ultimate strength, fails by deflecting laterally under a stress much less than that for short specimens of the same material. When the short specimen is composed of a ductile metal, similar to that in these wires, failure usually occurs by lateral flow of the metal, causing a continual increase in the cross-sectional area.

Usually, when a column fails, only one bend or kink occurs; but in the case of this wire the inertia of the material under the impact of the blow, so to speak, caused failure by lateral bending at many places simultaneously. Of course, this was possible only with the straightness of the wire and the axial direction of the blow due to the original stretching of the specimen to near its breaking point throughout its length. Eight of these kinks can be distinguished and it seems rather remarkable that the distance from one to the other along the wire should be almost uniform, although they vary in the amount of bending.

A much more striking example of this same action is seen in Fig. 2. This specimen is a wire rope made of some light weight alloy, probably containing aluminum. It is 7/8 inch in diameter and composed of five layers of wires, each 0.09 inch in diameter, a total of 61 strands in all. The photograph shows very clearly the regularity with which these strands are bent to form a symmetrical cage. On either side is seen a rudimentary cage whose development was arrested by the relief of the compressive stress as the center cage enlarged.

The only strand which appears to be unsymmetrical is the center one, which was originally straight. This one may be seen running nearly straight to the center of the cage from the left-hand side, then bending sharply upward.

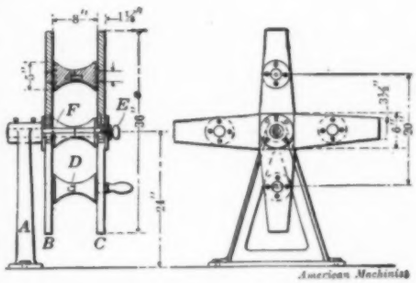
Reel for Coiling Wire Cable

By J. C. Bonnett

In a shop where wire cable is handled in considerable quantities a reel for coiling lengths up to 300 feet is shown in the accompanying cut.

It is permanently bolted to the floor at one end of the stock room. The large reels containing 2000 feet or more are arranged in a row at the other end mounted on trunnions so as to be free to revolve. The floor between is divided into five-foot intervals marked with brass tacks driven into the floor so that it is quite an easy job to carry the end of the cable across the room, cut of by the marks on the floor, catch the end in the opening in one of the reel spuds, a few turns of the handle makes a well shaped coil for tying which is done before taking off. To remove, it is only necessary to unscrew the thumb screw in the end of the shaft when the outer half of the reel is slid off. The shape of the spuds gives the whole bundle a rounded form best suited for handling in shipping.

The principal dimensions are given. *A*, is in this case an old solid box hanger used as a floor stand, the 1 7/16-inch cold rolled is secured by set screws. The reel arms are made of hard wood having flanged iron bushings in the center secured by wood screws. The two sets of four



Reel for Coiling Wire Cable

arms of the reel have attached the wooden spuds turned spool shaped, and firmly secured at each end of the arms *B*, *C*. Each of these spools is cut in two at the center or smallest diameter. One carries a small projecting pin in the end to locate the ends opposite each other. The opposite one has a slot cut out at *D*, large enough to readily admit the end of of the cable to be wound.

It will be seen that the reel arm *C*, with the attached spuds is free to be slid off the shaft by unscrewing the thumb nut *E*, thus allowing the coil to be removed, the remaining part of the reel is held in position by cotter pin through the shaft at *F*. The whole thing is inexpensive and has proved a most satisfactory device.

Cutting Off by Grinding

In response to many inquiries regarding the use of grinding wheels for cutting off material, we present information as to actual work which has been done with one of these machines.

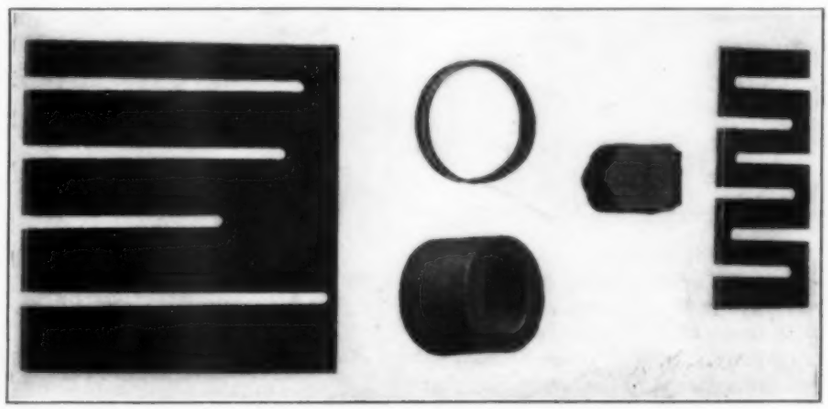
Corundum wheels, grade 5 E, No. 4660, 3/32 inch thick by 12 inches in diameter is recommended as being especially adapted to this work. These are run at 3000 revolutions per minute for the full-size wheel and increased to 4000 per minute as it wears away; in other words, maintaining a surface speed of from 9000 to 10,000 feet per minute.

One of the essentials is to have the spindle boxes nicely adjusted so as to prevent chatter, as this, as well as crowding the work against the wheel, shortens its life materially.

High-speed or hard carbon steel 1/4 inch thick can be cut at the rate of 3 inches per minute; hard, solid stock one inch square can be cut in one minute. Brass tubing 1 inch in diameter and 1/8 inch thick requires 10 to 12 seconds; thin tubing, such as bicycle tubes from 3/4 to 1 inch, requires 6 to 10 seconds; brass, nickel and other soft materials require about one-half the time of high-speed steel.

While the life of the wheel is not easy to state, as it depends so much on the way in which it is used, it is stated that from 1000 to 1500 cuts of 5/16-inch square high-speed steel can be made with one 12-inch wheel. The belt capacity of these machines is about 6 horsepower as a maximum, although very much less than this is usually required.

This information, together with the samples shown in the illustration, was supplied by the Matson Machine and Tool Company, Bethel, Vermont.



Work of a Cutting-off Wheel

A Scraping Machine and Some Tools

By F. A. Stanley

A power-driven reciprocating device for sliding work that has to be scraped to and fro on its bearing surface. An arrangement of reversing belts and pulleys with suitable controlling mechanism for giving the work any desired length of travel. How boring-mill saddles, tool rams, etc., are scraped to a proper bearing with little wasted effort upon the part of the workmen.

A handy appliance for picking up heavy cross rails for transportation about the shop. Construction of a reamer with two heads nearly a foot in diameter, and having inserted adjustable blades.

Of the numerous labor-saving appliances at the King Machine Tool Company's shops at Cincinnati, Ohio, none is of greater interest to the visitor nor more highly appreciated by the workmen immediately concerned, than the scraping machine illustrated in the halftone engraving, Fig. 1. The machine shown is one of a number built and installed at this plant to facilitate the scraping of heavy boring-mill saddles to cross rails, the scraping in of rams to the heads, etc. By their application the laborious work of sliding such heavy castings to and fro by hand is entirely eliminated and the drudgery attendant upon the process of scraping has become in this shop a thing of the past.

Some Features of Construction

The machine consists primarily, of a heavy bed plate, upon which is mounted a pair of adjustable supports for the work, with suitable driving and reversing mechanism mounted at one end for reciprocating the saddle or other part which is being scraped to a bearing. In the illustration a cross rail for a large boring mill is in place upon the supports and one of the saddles is represented as connected to the reciprocating rack by which it is slid back and forth along the rail.

The supports for the rail are semi-circular in form, and rest upon two rolls each, so that the rail when mounted upon the flat tops of the supports may be readily tilted to any desired angle to suit the convenience of the scraper hands. The rolls upon which the semi-circular supports are carried are of large diameter and the two supports roll so easily that there is no possibility of distorting the cross rail in the scraping machine. Two bolts that pass through slots in the rolling supports, hold these securely when the work is tilted to the desired angle.

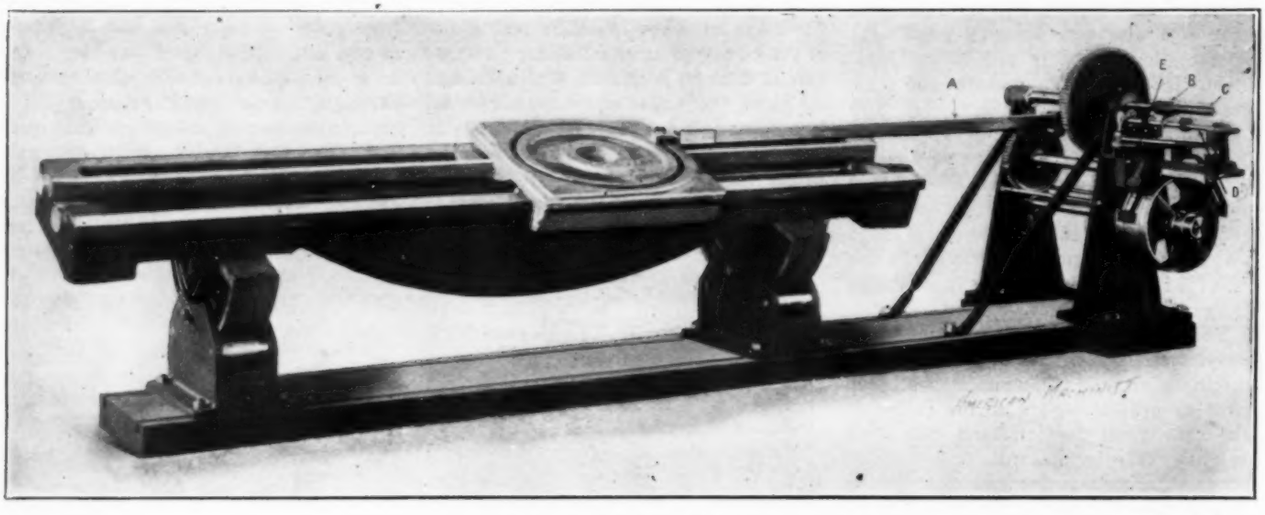


Fig. 1. A Scraping Machine

The Reciprocating Mechanism

The operating mechanism is quite similar to a planer drive with its open and crossed belts, reversing pulleys, link-controlled belt shifter, etc. The drive is from a small pulley on the main line as, contrary to modern planer practice, a very slow traversing speed is required. The driving shaft on the machine transmits motion through two pairs of reducing gears to the top shaft, and a pinion on this shaft, concealed in the engraving by the large gear, actuates the rack *A*, which has a swiveling connection at the outer end by which it is attached to the saddle requiring to be scraped. The rack slides in suitable guides that hold it square and in proper engagement with the pinion.

The reversing device is controlled by a yoke *B* that is threaded internally to fit the screw *C* which is rotated by the top shaft. *B* travels to and fro between two adjustable dogs on reversing rod *D* and the position of the stops determines the length of stroke prior to reversal. Rod *D* is provided near the end with rack teeth which engage with a segment for operating link *E* which in turn controls the belt-shifting device. As the gearing travels very slowly, the momentum is insufficient to accomplish directly the work of shifting the mechanism, therefore a pair of stiff compression springs (not visible in the engraving) are introduced between the part *B* and the dogs on rod *D*, so that the arrangement works on the "load and fire" principle and the reverse is obtained with smoothness and reliability.

Adaptability of the Machine

The length of travel is readily varied to suit the work and the handle on the reversing link provides a means of controlling the movement of the saddle by hand where desirable. The longitudinal adjustment of the supporting blocks along the base of the machine permits rails or other members of any size within the ca-

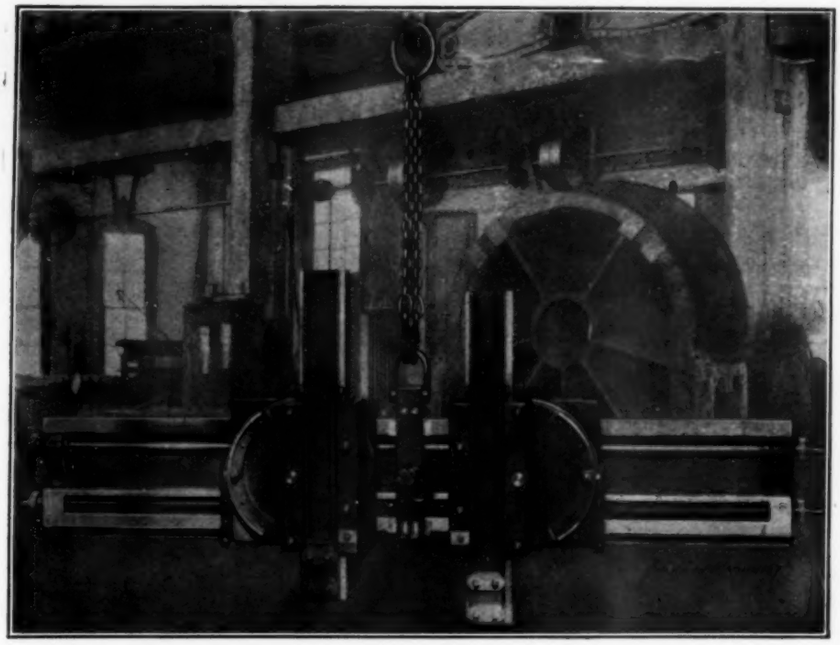


FIG. 2. HANDLING A HEAVY CROSS DIAL FOR A BORING MILL

pacity of the machine to be properly mounted for the scraping operations, and the apparatus slides the heaviest saddles on their rails and the lighter rams or tool bars in their heads, with equal ease; although, naturally, the heavier the work, the more pronounced are the advantages presented by the employment of the mechanical reciprocating device over the customary method of moving the work to and fro by manual labor.

It is apparent that a machine of this type, utilized in conjunction with suitable means of lifting the saddle from the bench, lowering it on the cross rail, swinging it back to the scraping bench and permitting it to be turned over with ease, reduces to a minimum the physical effort required in scraping heavy machine parts of this character.

LIFTING HEAVY MACHINE PARTS

The illustration in Fig. 2 is presented as representing a convenient method of hoisting such parts as heavy cross rails. The shackle shown at the center of the rail is a characteristic appliance which enables work to be readily handled about this shop. It is so constructed as to allow the rail to be lifted edgewise as shown, or, if during the process of handling the casting it is desired to turn the rail over, or lift it flat face up, the crane hook can be slipped into the ring in the face of the appliance.

It is equally useful for handling the cross rail either with or without the heads in place; for swinging it on and off machines and for placing it upon its own uprights, and it allows the rail to be transferred from point to point with safety to the workmen and to the finished work itself.

The cross rail shown suspended in the engraving, is for an 84-inch boring mill and is 12 feet 3 inches long. It weighs with the heads nearly 4 tons.

A LARGE REAMER

The reamer in Fig. 3 is for sizing the

FIG. 3. A LARGE REAMER

bearing for a boring-mill table spindle, and it is without doubt, the largest reamer of this type ever constructed. There are two sizes of heads carried on the bar, the lower being 11¾ and the upper 12 inches diameter. Each has 24 inserted blades. This tandem reamer is about 4 feet long and it is so heavy that an eye bolt is screwed into the end of the shank to allow the crane to be used for moving it from the tool room to the work.

In operation, the reamer is rotated by a special gear-driven attachment which is mounted directly upon the machine in which the bearing is to be reamed, and the spindle of the driver is connected with the squared shank of the reamer.

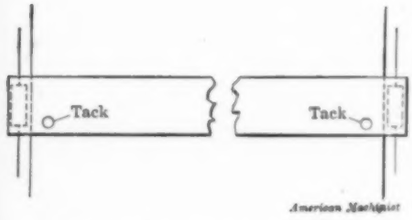
The reamer blades are taper on the inner edge and rest on a sloping surface at the bottom of the slot, so that they may be expanded by driving back in their seats. For grinding, the reamer is placed between the centers of the heavy Norton plain grinder.

There are several reamers of this type used in the King shops, for different sizes of mills, and the one illustrated is adapted for two different machines by changing the position of the upper reaming head to give the required spacing between the two reamers.

Anti-Tipping Pulley T-Square

BY R. A. RUDOLPH

As a general thing T-squares on the well known pulley-type drawing board, possess the evil of tipping up in front so that triangles slip beneath. This necessitates continual holding down of the T-square, which gets quite tiresome. In order to obviate this I have devised the



ANTI-TIPPING PULLEY T-SQUARE

means illustrated in the sketch. It consists merely in placing a common round-head tack on each end toward the back.

The National Museum of Arts and Industry, at Washington, is soon to receive the "June Bug," Glenn H. Curtiss' first aëroplane, and the first machine to make a public flight in the United States. The museum authorities are to be congratulated on obtaining such a prize for their collection.

Estimator, Rate Fixer and Inspector

By A. S. Forman

A foreman's views of increasing output by systematizing shop conditions, introducing piece work and employing an estimator, rate fixer and inspector. A plea for co-operation between these men and the foreman.

Multiplied output is the modern idea, and the essential of success in manufacturing. In effecting the existing increased output, the improvements in machine tools have played no inconsiderable a part. Multiplied outputs by machines and by machinists are, in a rather narrow and circumscribed sense, analogous; and yet essentially dissimilar. In some departments of the same concern they run side by side, and are synonymous; while in others they are totally distinct factors of the machine-shop equipment. For example, choose a works engaging a couple of thousand hands, men, boys and girls, building large steam engines, motors, generators and their accessories, of lesser dimensions. A part of the work will require to be done by fully rated and skilled mechanics, while a considerable part will be executed on "semi" and "full" automatics, a large number of these being superintended by one or two fully rated and experienced mechanics, assisted by one boy, girl or man to each machine.

It is to the fully rated, skilled man that attention is, for the moment, claimed, for it should be carefully noted that, though the success of the "full automatic" and unskilled labor is all but assured, in reference to the precise area which they can possibly cover, employers will, for a considerable time at least, have to reckon with a percentage of fully rated, skilled men, which it will be absolutely necessary for them to employ as the "vertebra" of their large manufacturing concerns.

These men, clever, all-around mechanics with an abundant fund of collected information, it is well known, are becoming fewer and fewer, and one fears to look ahead lest one has visions of a shop full of automatics with no skilled men to supervise them; paradoxical this appears, and there is a certain satisfaction in the concession and acceptance of the apparent fact that, possibly with no skilled mechanics there will be no automatics.

"It is no use pining for the good old times," as one distinguished writer so recently said; but in the times referred to lads were honestly and conscientiously taught the trade of the machinist. It is far different now and the result is disastrous. Apprentices are kept to the job which they are found to be most suitable for, and at the work by which they are able to bring more profit to the shareholders. The boys' future and their prestige as all-around mechanics are made subservient to the company's profit. In short, apprentices are not now able to learn even the practical part of their trade in the shops; so evident is that fact that schools and laboratories are arising for the precise purpose of equipping the lads with the class of knowledge that used to be acquired by them in their workshops. It is gratifying to those who dread to see manual skill going to the gutter, that there seems to be an awakening to the fact that in order to have the skilled mechanic, it is necessary to train apprentices apart from the shops to which they are attached.

Multiplied Output from Skilled Men

How can we best secure multiplied output from skilled men? How is the very best that they can do to be secured for the good of their employers and themselves?

It is of no use to inflict a system of extortion upon them, especially if it be that a particular staff of men are of special service, and the questionable resource of discharging and replacing with others does not half fill the bill.

"Sack the specially useful ones, for nonsubmission to predatory incursion, and replace them with others less useful, and less submissive still." That cannot be the way of the wise. No, the only course and a sure and a safe one is to recognize their special merit and accruing value, be fair and square and pay *according to merit*, both as regards quantity and quality of output.

It may be taken as axiomatic that these men have come to stay and to continue to satisfy their legitimate demands means profit to their employers. Twenty-five years' experience as machine-shop foreman is more than sufficient to convince one of that; and in that time many things become familiar to him, which would do no harm to employers to learn. Now, in close analogy to the foregoing, probably no subject has been the cause of more controversy in engineering works than the vexed one of time-work versus piece-work. It seems strange unless one is familiar with the cause that a large quantity of work is now done on a time-work basis while piece-work—based on a sound principle and fairly administered—is the essence of fairness.

An attempt will be made to make clear the inherent faults of present-day methods of piece-work payments, and the sequel will show a reason why the foreman allows a considerable quantity of work to go through the shops on a time-work basis.

The Cycle of Piece-work

When piece-work or a new price for a new job is introduced into a shop, the cycle is generally thus: A man whose rate per hour may be nine-pence raises this rate by dint of extra exertion of body and brain by 50 per cent., making it one shilling and three half-pence per hour.

This the employer deems too much for the man to be allowed to earn and reduces the price of the job. The man thereupon further increases his efforts and, if not at once, by constant application and practice to one particular piece of work is probably able to reduce his time and to raise his pay 40 per cent. above his day rate. The price is again cut; and so it goes on until it becomes a matter of scamped work and sweating. The former the employer cannot tolerate; the latter the workman resents, and either gets dissatisfied and leaves or stays in the shop cherishing a feeling which is known to be directly opposed to the best interests of the firm. That is a typical instance of that which occurs in many cases.

Now when an employer pays what is known as a fair day's money he naturally expects what is generally accepted as a fair day's work and no more; but when piece-work is introduced the weekly wage bill shows a marked increase. This is obviously in the natural order of things; but when this inevitable result occurs the employer forgets he is obtaining an excess of the fair day's work, and that the mechanic who turns out the greater quantity of work than heretofore, is honestly entitled to proportionately higher payment. Surely it is known, if not it will do good to confess it, that quick workers will actually idle away their time rather than exceed a certain quantity of work in a specified period, knowing that if their wages rise by more than 20 per cent. or 25 per cent. above their day-work rate the price will surely be cut down. In fact, officials are kept for the precise purpose of keeping the rise in rate about normal.

The quick workers abound and they hold back for the sake of the slower worker who would stand to suffer if prices were cut. Apart from feelings of sympathy for the slow workers it is not by any means uncommon for mechanics to have a precise and exact time limit for different jobs; woe be-

tide him who reduces it. His position in the shop is made uncomfortable so that under these conditions the quick and clever worker is no better off than the slow worker.

It is freely acceded that a perfect piece-work system is not easy to devise, but it is at the same time most persistently asserted that the base of any successful method must be strict integrity and absolute faith in each other; that is, between the foreman (who represents the man) and the manager (who represents the employer). But, by the way, it much too often occurs that the setting and cutting of piece-work prices is placed in the hands of an under man with pernicious results. He has his own place to make and does it by showing low rates, but it must not be forgotten that work often costs less by raising the piece-work prices.

What the Foreman Can Do

The dodges than men can and do resort to for the purpose of circumventing the distrusted employer are manifold. Nothing is sound and systematic and it is a constant fight with officials at one end and men at the other, week in and week out. To adjust piece-work prices an exceptionally capable foreman mechanic is an absolute necessity. His character must be above suspicion of possible bribery; other things being equal he is the man to price the job. If it is not possible to fix a price, or at least difficult to do so, he has a substantial alternative at hand. He can have the job set up on lathe or planer, and he can all but do the job himself, taking personal control of all the operations. By this method he is well able to judge what constitutes a fair piece-work price for the job and, having found this, no matter how much the mechanic might be able to reduce the foreman's time the price should no more be cut. This system is far removed from the farcical system of pricing from the office by men who never see the job, and who would know very little about it if they did. The foreman would for his own credit's sake see that the output of work would be consistent with the prices set, good records would be made for future estimates, and it would be to the direct financial good of the men to turn out as much work as possible. This would benefit the employer in a proportionate degree.

So it appears that if a piece-work system is wisely administered and fairly remunerated, all are gainers; the more work done the more wage paid and the more profit in a certain time. It is obvious that such expenses as rent, rates, light and management would increase but little. It will be easily noted that nothing has been urged but what has been put forward previously under different form, perhaps. The foregoing is my intense conviction.

Reference will now be made to the estimator, rate fixer and inspector, giving honest expression of opinion from the foreman's position.

The Foreman Himself

Close, and even superficial observers are able to perceive that the ability and prestige of the shop foreman are far in advance of that old and one-time accepted idea, that "in the day time he was a swearing bully and at night a sponging guest." By close study of standard books and current literature, he has made himself a competent critic of the various innovations which are from time to time introduced into the workshop. It is not a case of criticism in the absence of facts nor of comment without information. He makes himself familiar with all that comes around.

He may be quite as much in touch and in accord with the offices of those referred to at the head of this article as the managers themselves. He certainly has the advantage of being precisely familiar with the probable consequences of the introduction into the shops of the system which has required the services of an estimator, a rate fixer and an inspector.

With other foremen I am in close accord with a system of the kind referred to if it is wisely administered. As an intelligent machinist, I cannot withhold my full approval of their introduction, always presuming that these officials are fully capable of discharging their difficult duties.

Umbrage is taken at the manner in which these useful officials are ushered in and to the way under which the system which embodies them is administered. There is obviously a right way, and there is a wrong way to do everything; it seems to us that our esteemed managers do not always choose the right one. They suddenly contravene a long-standing custom of the shops which they have the privilege to superintend, in a disastrous way. For example: A trusted foreman of the class that has been portrayed may have been for years absolutely depended upon for estimates for work, with which he is known to be particularly familiar and closely associated. He has been accustomed to base his estimates on his practical knowledge and extended experience, supported by data of his own and of that which he has access to from the office records.

How the System Is Started

Suddenly, without preparation or warning, an estimator is engaged and following him a rate fixer and an inspector; all good in their way and, introduced with good generalship, harborers of great good for the firm.

But the manner in which all of these are "pitchforked" in is the precise cause of trouble.

They are generally men of moderate ability, a kind of half-clerk and half-mechanic but brilliant in neither capacity. They get to work on a pen-and-ink basis in a more or less perfunctory way, discharging what they consider to be their duty, that duty being—as regards the estimator and the rate fixer—to reduce the estimated cost and lower mechanics' rates.

Naturally both these respected officials seek to make comfortable and lucrative positions for themselves and, with this precise object, the estimator places his figures low, the rate fixer bases his piece-work prices on the estimates, low again.

The work comes into the shops, with the rates and sequential operations following and then trouble commences. The rate fixer is possessed with the absurd idea that if he fixes his price low the men will aim at getting the work done near the price given. But it may be accepted as an absolute fact that nothing was ever farther removed from the semblance of fact, for a conscientious piece-worker will not aim at that which he knows to be impossible. He must have a price by which he, by working hard and dexterously, can earn the recognized amount above his day rate. If he knows this to be impossible he takes little care to push the job through quickly. The foreman perceives this and is executively responsible for the man's behavior. But what remedy has he? He can, if he chooses, discharge the man, but what does he or his employer gain? Another man comes along and is put on the same job—and the cycle is repeated.

Who is responsible? Surely the foreman is not, for he, knowing his men and machines, is familiar with the capabilities of each, would gladly have given the rate fixer the benefit of his experience, and would have advised a price ultimately satisfactory to both sides. This would have been less than the job would actually cost on the rate fixer's absurd price, the job would be done in less time, the machine rates and other rates lowered, the job would be out in less time, and nothing but harmony and good feeling would be paramount. These are facts known, apparently, only to those inside the shops.

In reference to the foreman and his relations with the rate-fixing and the estimating departments: He is not averse to, but the contrary, with these officials; if they were appointed to work with him instead of independently of him, he would be in full harmony and accord with the system which employs them.

But this is not the case. Generally the estimator fixes the proposed price of the job. The rate fixer sets the price for the shops. The foreman has no voice in the matter. Where is the evidence of good generalship in this way of working? Can a manager afford to ignore the opin-

ion, knowledge and experience of a man whose special duty is and has been for years to watch and control the cost of work? Is there any gain or profit attached to a system which absolutely ignores assistance, which the concern to a certain extent pays for? There is not. A system which engages men to ride rough-shod over the intelligent and hitherto trusted shop foreman is at fault, from the fact that it does not make the best use of the help at hand.

But the shop foreman is still a man of spirit. He is unable to take all these indignities "lying down." When he finds that his trustworthiness is being questioned, that his integrity and all abiding interest for his employers are in doubt, that his prerogative as boss of the shop has been assailed by those who might have easily benefited by his expert knowledge, he experiences a feeling of injury and injustice, vaguely wondering if his services have become less valuable to his employers. What wonder then, if he casts about and seeks a position where the "infections" do not obtain?

If he succeeds is not his employer temporary loser by his defection and desertion? A new foreman may be engaged. It is true he may be quite as good a man as he who has been driven out, but if he is a stranger he has a lot to learn before he is able with his other duties to exercise any kind of adjudication between the new officials and his men. So the affairs of the shop may be landed in chaos, until crippled production and the absence of all that goes to insure the financial success of the undertaking.

It would be wrong I think, to bring this to a close without a closer reference to the office of the inspector.

THE INSPECTOR

An inspector is an absolute necessity in all shops, and no concern is complete without one or more of them. But the class of man who is carelessly pitch forked into a shop is not, once in twenty, suitably equipped for this important position.

To explain: Six months ago an inspector was introduced into a manufacturing and repair shop in Glasgow, the absolute loss to which that firm has been subject is well known by some.

The men—turners, slotters, planers and borers—were as good a lot of picked men as one could find on either side of the Atlantic.

They knew their job—the parts which had to be turned to the micrometer or the vernier and could and did work to half a thousandth as well as the next men. But the inspector made a shocking mess of things; sending large details back to the machines which were not to size by a few thousands when a sixteenth, or even an eighth of an inch would not have mattered; condemning this, and rejecting that at wholesale; the foreman having to make a personal appeal to the manager to pass them. It is "all very well" for a man a little expert with accurate measuring devices to fancy he is an efficient inspector; if his duties simply comprise the careful measuring of details all would be well. But an efficient and profitable inspector must be a mechanic with a well developed bump on the practical and commercial side. He must be familiar with the job from a machinist's view-point and grasp the fact that perfect accuracy is all but impossible; he must not get around wasting his time and his employer's money by scraping all he comes across in a haphazard manner, on account of its being a thousandth or two out. That job a lad could do, but to be an inspector worth his salt demands immensely more than that.

Cutting Spiral Flutes on the Planer

BY HENRY M. WOOD

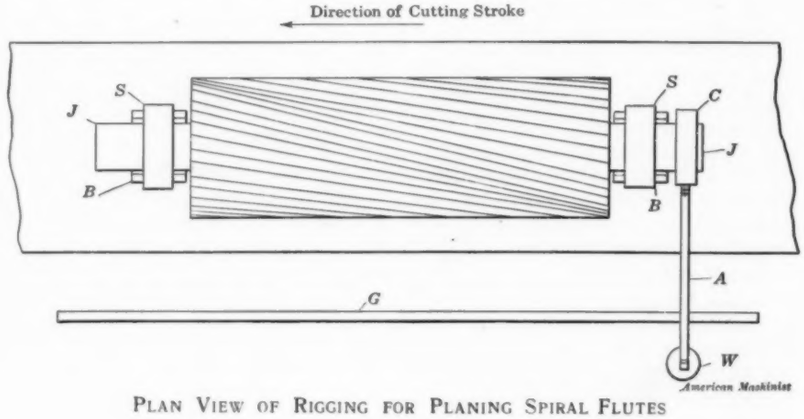
The Adamson Machine Company, Akron, Ohio, does quite a business in redressing old cast-iron rolls for the various rubber manufacturers in that city. These rolls run about 20 inches in diameter and 10 feet in length outside of the journals. They are scored with a number of steep pitch spiral grooves.

The first operation in redressing a worn roll is to turn the outside to a cylindrical surface. The roll is then mounted on the table of a 36-inch planer, as shown in plan view in the accompanying diagram, for cutting the spiral flutes. Since the surface of the roll is chilled, a special countershaft is necessary to reduce the cutting speed of the planer to about 2½ feet per minute. The journals *J J* of the roll are mounted in V-blocks *B B*, located in the center T-slot of the table. Straps *S S* hold the journals in the blocks, but are fitted sufficiently loose that the roll is free to oscillate in the V-block bearings.

A collar *C* is fitted over the end of the front journal and clamped to it by several set screws around the circumference of the collar. An iron rod *A* is threaded into this collar and the collar clamped in such position that the rod extends approximately in a horizontal direction to the left. A guide bar *G* is attached by a C-clamp near the top of the left-hand planer housing and from there extends nearly to the floor at the front of the planer bed. A weight *W*, attached to the outer end of the rod, keeps the rod always in contact with the guide bar.

As shown in the diagram, the several parts are in position for beginning a cutting stroke. During the cutting stroke the horizontal rod slides along the guide bar so that the end of the rod is gradually and uniformly raised. This gives the roll a right-hand rotation. The combination of these two movements results in a true spiral cut. The pitch of the spiral can, of course, be varied to any desired extent by varying the angle at which the guide bar is clamped.

No indexing mechanism is provided, because it is not essential that the flutes be spaced with exact evenness. The old flutes serve as sufficient guide for the indexing. By moving the planer head a short distance to the right and to the left of the center line of the roll it is possible to cut three flutes without loosening the set screws to change the collar for a different indexing of the entire roll.



PLAN VIEW OF RIGGING FOR PLANING SPIRAL FLUTES

Congress of Technology

A Congress of Technology will be held in Boston on April 10-11 in celebration of the fiftieth anniversary of the granting of the charter of the Massachusetts Institute of Technology. In line with this idea, the fifty or more papers which will be presented at the Congress will be written by graduates of the Institute, and will thus serve to make the proceedings of the Congress show the general industrial advance that has taken place during the past 50 years under the guidance of trained engineers and will serve to show the potent influence of the Massachusetts institution.

Letters from Practical Men

Concerning the details of making things in machine shops, from the first sketch to the shipping room. A letter good enough to print will be paid for. The value is in the idea—not the length of the letter

Boring Thrust Blocks

We have had great difficulty in machining thrust blocks, which are cast in halves. The block which is of cast iron is over 6 feet long, has 16 thrust rings 15 inches in diameter, 4¼ inches pitch, the diameter of the shaft being 11 inches. To machine this is no easy task, as all the rings fitting between the grooves in the block had to be interchangeable. I thought of a plan which costs very little, most of the material being picked up around the shop, and when finished the jhe job was only 0.006 inch out in the 16 thrusts. The saving was 50 per cent. over the old way of swinging the blocks on a 10-foot face place.

I got two facing slides *A* exactly alike from horizontal boring machines. These facing slides were threaded inside the boss to attach them to the spindles of the horizontal boring machine. I next got out an old self-acting boring bar *B*. This bar had a screw, four threads per inch, for traveling the cutter head. I threaded both ends of the boring bar, cut about 20 inches off screw and slid rings on the bar at each end to suit the length of the screw. This alteration on the screw was made so that the screw would not interfere with the facing slides at both ends of the bar and also to enable the workmen to turn the screw to suit the pitch of the rings. In fitting the ends of the bar to the facing slides I saw that they were screwed hard on the bottom of the boss, and also that the slides were exactly in line with each other.

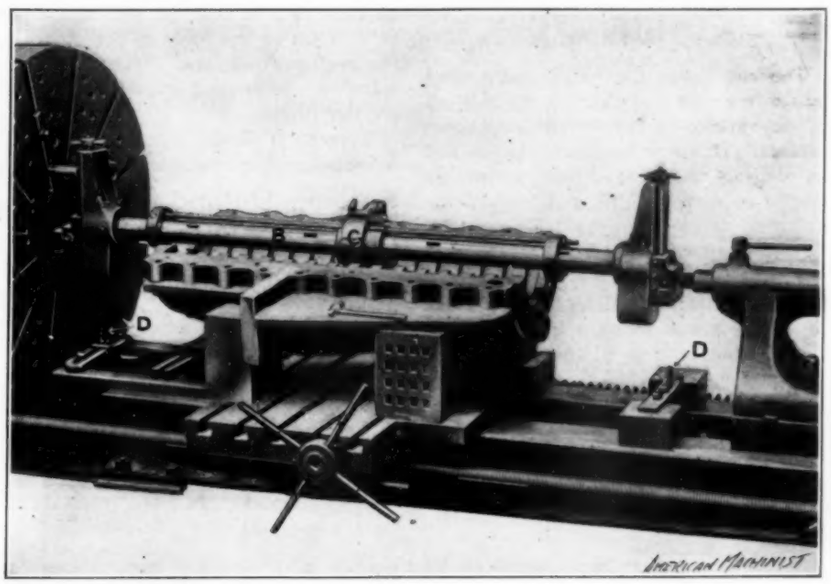
The holes where tools are inserted in the facing slides I plugged with square steel pieces which had 60-degree centers in them. The plugs were tightened by set screws in the way a tool would be tightened. I next drilled two ¾-inch holes through the boss and bar, when the bar was screwed hard up, and fitted two ¾-inch turned bolts. This was done to prevent the facing slides *A* turning on the bar *B*. I then had a boring block keyed on the cutter head *C*, with a tool on each side of the block, the tools being 4¼ inches apart, thus doing two grooves at a time. To get the pitch desired, 4¼ inches, the screw on the boring bar was given 17 complete turns, giving an accurate division for the thrusts. The pins *D* for feeding the bar from the center of lathe were arranged on the bedplate of the lathe, and fixed to turn the starwheels on the facing slides exactly at the same moment. The depth of the thrust rings was 2½ inches into the block, this was marked after the first ring was done on the side of the facing slide, the workman saw at once when to stop and move the block to another ring.

The halftone shows the arrangement with the top half of the thrust block removed, showing the bar, block and work done.

This method ought to prove useful in marine shops for thrust blocks.

JOHN MCILWAINE.

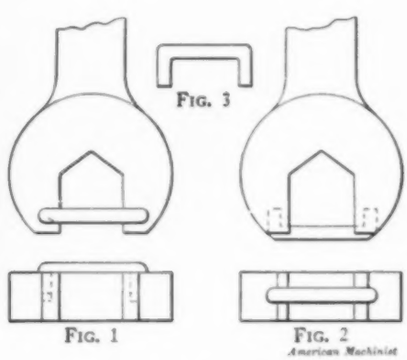
Paisley, Scotland.



BORING THRUST BLOCKS

Reinforced Wrench Jaws for Abnormal Strain

Bolts and nuts, after being long together, especially when in exposed places, often seem to be almost inseparable. The illustrations show two bridged wrenches designed to withstand an abnormal strain, making them suitable when a nut has seized. Fig. 1 shows one style, with the bridge in front, the wrench assuming box form and applicable from the top of the nut. Fig. 2 shows the bridge on the side of the jaws, this style is suitable for corner application. Fig. 3 shows the bridge formed from a piece of mild-steel bar, of a suitable diameter, proportionate to the size of the wrench. The tails of the bridge must be a drive fit into the accommodating holes in the wrench jaws.



REINFORCED WRENCH JAWS

ANDREW WEBSTER.

Glasgow, Scotland.

Grinding a Cupping Tool

Two grinding operations performed on the cupping tool, shown at *A* in the accompanying cut, which is used for cupping out main-spring barrels, may be of interest to some of the readers of the AMERICAN MACHINIST. Few preliminary arrangements are made for grinding when only a few of these are needed, but when made in lots of 40 or 50, it is desirable to have tools and a good method of handling, to facilitate the work.

The angle of the tool in process of grinding is shown at *B*. As indicated, the feed screw has been removed for the purpose of permitting the slide to be moved to and fro, while the adjustment of the wheel to the work is made through the handle of the upper slide. A recess was turned into the side of the wheel a short distance from its periphery, thus making a complete passage of the wheel across the work unnecessary, and consequently shortening the stroke of the slide. The gib screws of the lower slide were so adjusted that it responded to a slight push or pull when it moved across the work by hand.

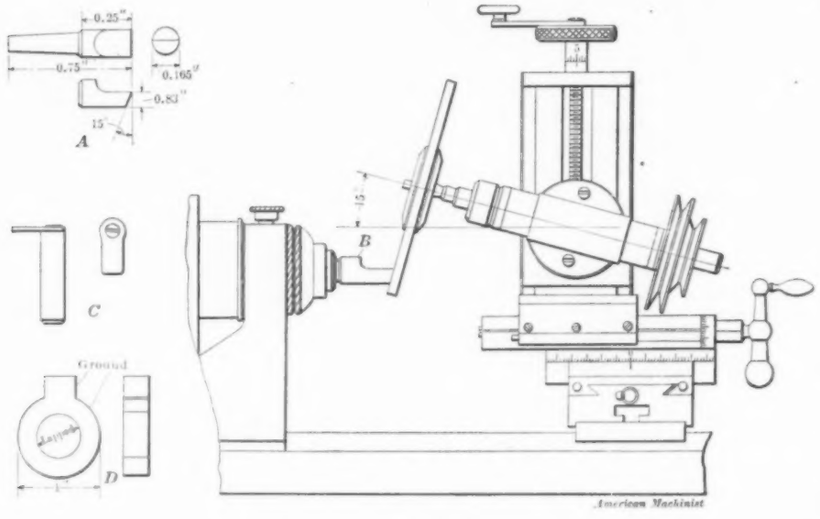
The cutters were all milled to the same size, leaving 0.003 or 0.004 of an inch to grind, and after hardening they were first ground to the required diameter, the angle or cutting edge being ground last.

In reference to the sketch, the semi-diameter of the tool is sometimes ground with the slide-rest grinder, setting the flat part square with the lathe bed, but the objection to this is that it leaves the surface concave when the wheel is traversed parallel to its length, so I prefer the following method: A tool is placed in the chuck with the flat side down, and the gage *C*, fitted to the T-rest, is so adjusted to it, that when the work is indexed half-way around, the flat side is up and ready to grind; then the milling attachment is set to zero and the lower slides moved to and fro with the left hand while the right operates the feed-screw handle.

A corundum wheel, 120 grain was used, which was reduced very little in diameter after grinding 50 cutters, and by noting the graduations on the milling aftachment, accurate measurement was easily obtained.

At *D* is a job of transverse cylindrical grinding, which can be done by removing the screw from the upper slide and setting the milling attachment so that it can be fed across the work in the same manner as described. The usual way of grinding the circular portion is to use a chuck-quill and rest, containing a worm and wheel attachment for revolving the work, which is placed on a suitable arbor, but it is not necessary to have the attachment, as the arbor can be turned up in the lathe head, revolving it by operating the draw spindle or any other means that the shop affords.

Elgin, Ill. GUS. HAESSLER.



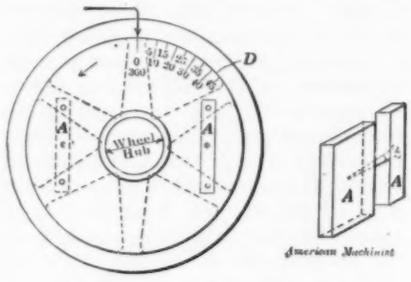
GRINDING A CUPPING TOOL

Charting the Movements of a Machine

The cut shows the arrangement used by me in timing and charting the motions of the various parts of multiple plunger presses. This was necessary, as we had an entirely different article which we wished to make in the machine and the firm that made the press did not see fit to furnish us with a cam chart.

The dial *D* was made of heavy strawboard of suitable diameter for the wheel to which it was to be attached, in this case 24 inches, and it was divided into 72 equal parts on the circumference, so that each division represented five degrees. It was fastened to the wheel by means of the clamp blocks *A*, to which it was fastened by means of thumb tacks.

The zero point was found by rocking the crank shaft. An index was then located directly above this point. The position of the moving parts was then noted, each part being measured for movement. The shaft was then turned 5 degrees and all measurements again taken. This was continued until the cycle



CHARTING THE MOVEMENTS OF A MACHINE

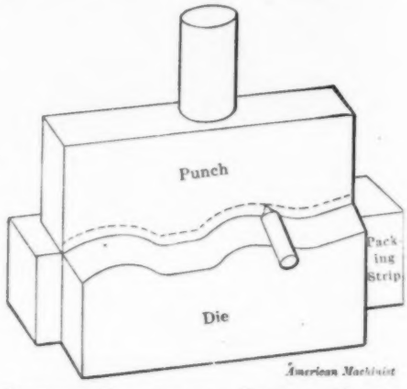
was completed, after which the chart was made from the measurements.

We made our tool-lifter cams to suit the chart and located the roll positions on each cam so that the tool setter had only to fasten the cams to the sleeve in the positions indicated. Thus we eliminated all doubt and guesswork in timing our lifters.

Waterbury, Conn. MODERN.

Scribing Outline for Bending Punch

The perspective view illustrates a ready means of scribing the correct outline of bending punch, to suit a finished bending die; the outline of punch, of course,



SCRIBING OUTLINE FOR BENDING PUNCH

differing from that of the die by the thickness of the metal to be bent.

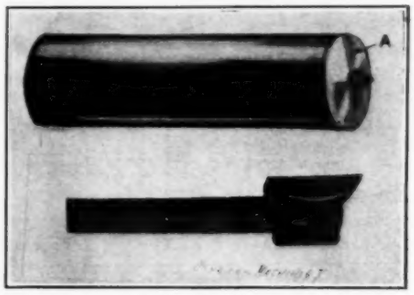
The scriber shown is turned to a diameter exactly equal to twice the thickness of metal to be bent, and made with a concentric scriber point which is hardened and suitably tempered. The radius from the point being equal to the thickness of metal, it will trace the exact form required when used as shown.

Earlswood, Eng. G. E. G.

Turning Hardened Steel

An interesting little job of turning hardened steel was recently done in the shop of the J. D. Mallonee Company, Mount Vernon, N. Y.

The part that was turned and the tool used, are shown in the halftone. The work was done in an ordinary bench lathe using a slow speed and feed, and the metal was hardened and only slightly drawn tool steel, while the tool used was a piece of sapphire about ½ inch long, 5/16 wide and 3/32 thick, which was cemented to a steel shank with jewelers' wax.



HARDENED PIECE OF STEEL AND THE TOOL USED TO TURN THE END

Shavings about 0.002 or 0.003 thick, 1/32 wide and from one to two inches long were turned off of the end of the piece at *A*, with this tool.

New York, N. Y. E. V.

Adjustable Spring Winder

Accompanying sketch shows a device for winding helical springs, either compression or tension. It consists essentially of two plates of ⅛-inch sheet steel bent at right angles on both ends.

The inside plate being free, is held in place by pin *B*. On the opposite edge of the inner plate, at each end, are 60-degree grooves *G*, with the widest part equal to the diameter of holes *F* in outer plate. These holes are ⅜ inch in this case. By placing winding rod *C* in position, as shown in Fig. 3, and tightening screw *A*, the winding arbor *C* may be any size up to ⅜ inch diameter, and yet always be firmly held.

We have wound spring steel 1/16 inch diameter with the greatest ease. Holding the device in the bench vise and inserting end of spring wire in slot *E* far enough to get a good hold, by turning and letting the spring wire run along the outside, you get a tension spring; or if a compression spring is wanted, let spring wire feed through slot *D*. For quickness and satisfaction it is all that can be desired. The idea is, of course, suitable for larger sizes.

CAMP ZUBLER.

Philadelphia, Penn.

Handling Long Tracings on Small Boards

It sometimes becomes necessary to work with large tracings on a drafting board too small for suitable accommodation, thus placing the drawing in a position of easy injury. A simple method for overcoming this difficulty is shown in the accompanying line cut, Fig. 1.

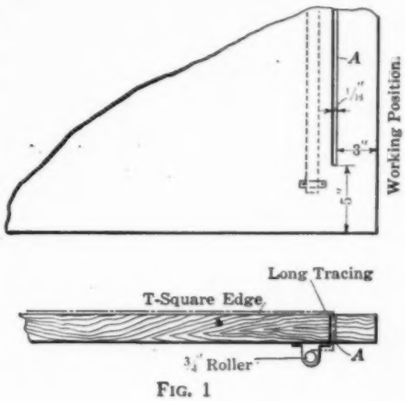


FIG. 1

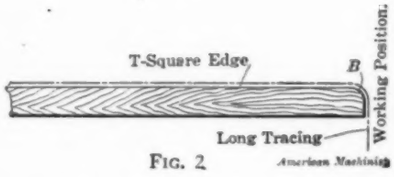


FIG. 2

HANDLING LONG TRACINGS ON SMALL BOARDS

A slot *A*, about 1/16 inch wide, is cut along the length of the board, 3 inches from the edge nearest the draftsman and in the neighborhood of 5 inches from each end. Allowed to pass through this aperture, the tracing is rolled beneath upon a plain wood roller about ¾ inch in diameter, suitably supported at each end with small metal hangers. The edge of the opening through which the drawing works should be slightly rounded to avoid creasing.

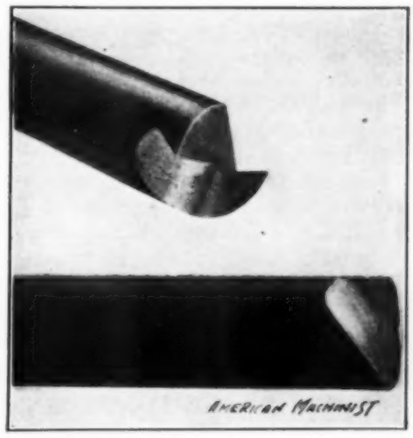
The scheme suggested in Fig. 2, rounding the edge of the board at *B*, the working position, will effectually save the tracing from being cracked, but does not afford the protection offered by Fig. 1; this former method gives a positively safe condition at trivial cost.

Los Angeles, Cal. L. R. W. ALLISON.

Truing Up Deep Holes

The accompanying halftones illustrate a tool I found successful for truing up deep holes, 6 in. deep, 7/16 inch diameter, bored in poor cast iron, where the drill ran out and an ordinary lathe-boring tool was too springy to get a good job.

After running a ⅜-inch drill through the cast iron I found it had run out about 3/64 inch at the rear end. I bored it to size about ½ inch deep with an ordinary boring tool. This ½ inch of finished surface acted as a guide for the tool herewith shown, which I made of drill rod. It is to size its entire length. The construction of the cutting end is clearly shown, the other end is centered so that the tailstock can be used to feed the tool to the work. I also made it somewhat longer than the depth of the hole so that a dog could be fastened on the end.



TRUING UP DEEP HOLES

In using the tool the lathe should be run as fast as the cutting edges of the tool can stand, feeding slowly with the tailstock, the dog being held in the hand so if it should happen to bind, it can be let go before any damage is done. I have found that the best results are obtained when the cutting edges are vertical.

After feeding this tool through the entire six inches I found the hole perfectly true and to size.

Urbana, Ohio. WILLIAM HENCHEN.

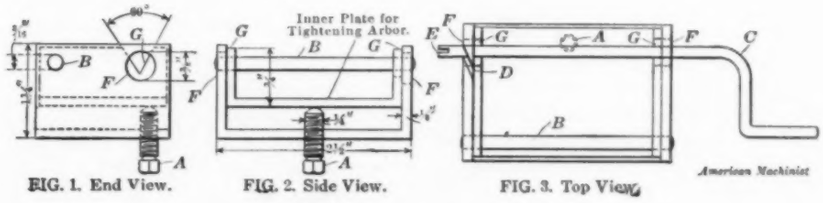


FIG. 1. End View. FIG. 2. Side View. FIG. 3. Top View.

DEVICE FOR WINDING HELICAL SPRINGS

Setting Angles to Mill Teeth in Angular Cutters

In developing the formula for determining the angles for setting the index head when cutting angular milling cutters, let us first establish a code of letters representing the given angles:

A = Angle between tooth lines or $\left(\frac{360°}{Number\ of\ teeth}\right)$;

B = Included angle of cutter used to mill teeth;

C = Included angle of cutter being milled.

We will first consider conditions when a 90-degree mill is used to cut the teeth. This is shown on Fig. 1, with the cutter drawn solid, similar to a countersink, to indicate more clearly the method of reasoning.

Before going further it may be well to explain that in referring to an angle as included angle of cutter, it should be understood the cutters are to be angular on one side only, but should the cutter being milled be angular on both sides it should be dealt with as two cutters; or, in other words, angle C will be the angle

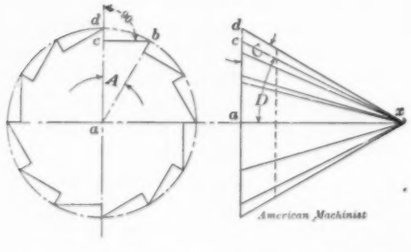


FIG. 1. DIAGRAM OF ANGULAR CUTTER

Number of Teeth.	Angle of Cutter Used. 90°	80°	70°	60°
8	22° 12′	18° 23′		
9	23° 51′	20° 25′		
10	25° 2′	21° 56′	18° 37′	
11	25° 54′	23° 4′	20° 2′	
12	26° 34′	23° 57′	21° 11′	
13	27° 5′	24° 40′	22° 6′	
14	27° 28′	25° 14′	22° 50′	
15	27° 48′	25° 42′	23° 28′	
16	28° 4′	26° 6′	24° 0′	21° 36′
17	28° 18′		24° 28′	22° 13′
18	28° 29′		24° 52′	22° 44′
19	28° 38′		25° 12′	23° 11′
20	28° 46′		25° 30′	23° 35′
21	28° 53′			23° 57′
22	28° 59′			24° 16′
23	29° 4′			24° 34′
24	29° 9′			24° 50′

ANGLES FOR SETTING INDEX HEAD WHEN CUTTING 60-DEGREE MILL.

between the face line and a line passing through the points of the teeth of the cutter perpendicular to its axis.

To enable us to eliminate unknown quantities and deal with given quantities as basis on which to figure, let us measure all lengths by a standard in which $a\,b = 1$.

The problem is to find angle D, Fig. 1, or to express its value in terms of known quantities. It can be readily seen to cut tooth $b\,c\,d\,x$; the cutter must cut on line $c\,x$. To accomplish this the head must be elevated D degrees to bring $c\,x$ horizontal.

Now, $Tan.\ D = \frac{a\,c}{a\,x}$. In this equation we must find known quantities to replace $a\,c$ and $a\,x$. The triangle $a\,b\,c$ shows that $a\,c = a\,b\ Cos.\ A$, and since $a\,b = 1$, $a\,c = Cos.\ A$. Similarly $a\,x = Tan.\ C$.

Therefore, $Tan.\ D = \frac{Cos.\ A}{Tan.\ C}$. As A and C are given, D is easily found. Now we find ourselves at a point where it will be easy to consider conditions when using a cutter having an included angle less than 90 degrees; this angle will be expressed, as before mentioned, as B.

To simplify matters we will show the cutter (being cut) in the correct position for cutting, Fig. 2. The arrow indicates the direction of feed of the cutter through the piece. I have aimed to show clearly in this sketch that in order to make $b\,x$ a cutting edge, the outer edge of the cutter (cutting) must cut along line $e\,x$,

Number of Teeth.	Angle of Cutter Used. 90°	80°	70°	60°
8	35° 16′	29° 25′		
9	37° 27′	32° 18′		
10	38° 59′	34° 21′	29° 24′	
11	40° 5′	35° 54′	31° 26′	
12	40° 54′	37° 4′	33°	
13	41° 31′	38° 2′	34° 15′	
14	42° 1′	38° 46′	35° 17′	
15	42° 25′	39° 22′	36° 9′	
16	42° 44′	39° 54′	36° 52′	33° 24′
17	43° 0′		37° 29′	34° 14′
18	43° 13′		38° 1′	34° 57′
19	43° 24′		38° 29′	35° 35′
20	43° 34′		38° 54′	36° 9′
21	43° 42′			36° 38′
22	43° 49′			37° 4′
23	43° 55′			37° 28′
24	44° 0′			37° 50′

ANGLES FOR SETTING INDEX HEAD WHEN CUTTING 45-DEGREE MILL.

Number of Teeth.	Angle of Cutter Used. 90°	80°	70°	60°
8	14° 26′	11° 55′		
9	15° 36′	13° 19′		
10	16° 24′	14° 19′	12° 7′	
11	17° 2′	15° 6′	13° 7′	
12	17° 30′	15° 45′	13° 53′	
13	17° 52′	16° 14′	14° 30′	
14	18° 9′	16° 38′	15° 1′	
15	18° 23′	16° 58′	15° 27′	
16	18° 35′	17° 15′	15° 50′	14° 13′
17	18° 45′		16° 9′	14° 38′
18	18° 53′		16° 26′	14° 59′
19	19° 0′		16° 40′	15° 19′
20	19° 6′		16° 53′	15° 35′
21	19° 11′			15° 48′
22	19° 15′			16° 3′
23	19° 19′			16° 15′
24	19° 22′			16° 26′

ANGLES FOR SETTING INDEX HEAD WHEN CUTTING 70-DEGREE MILL.

which makes an angle F, with the center line of the cutter being cut.

Now it is apparent that $F = D - E$; therefore, since we have already found the angle D, it will only be necessary to find the angle E.

Without going through the complete derivation,

$$Sin.\ E = \frac{Sin.\ A\ Cot.\ B}{\sqrt{(Cos.\ A)^2\ (Tan.\ C.)^2}}.$$

Since $E = D - E$, F (Setting angle) = (angle whose $tan. = \frac{Cos.\ A}{Tan.\ C}$ — (angle whose $sin. = \frac{Sin.\ A\ Cot.\ B}{\sqrt{(Cos.\ A)^2\ (Tan.\ C)^2}}$.

From these formulas I have computed the angles given in the accompanying tables. They have been carefully checked and are accurate to one-half of

Number of Teeth.	Angle of Cutter Used. 90°	80°	70°	60°
8	7° 6′	5° 51′		
9	7° 41′	6° 34′		
10	8° 7′	7° 5′	5° 59′	
11	8° 26′	7° 29′	6° 28′	
12	8° 41′	7° 48′	6° 52′	
13	8° 52′	8° 3′	7° 11′	
14	9° 1′	8° 15′	7° 27′	
15	9° 9′	8° 26′	7° 40′	
16	9° 15′	8° 35′	7° 52′	7° 3′
17	9° 20′		8° 1′	7° 16′
18	9° 24′		8° 10′	7° 26′
19	9° 28′		8° 17′	7° 36′
20	9° 31′		8° 24′	7° 44′
21	9° 34′			7° 52′
22	9° 36′			7° 59′
23	9° 38′			8° 5′
24	9° 40′			8° 11

ANGLES FOR SETTING INDEX HEAD WHEN CUTTING 80-DEGREE MILL.

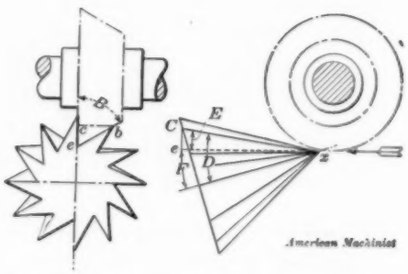


FIG. 2. DIAGRAM OF ANGULAR CUTTER BEING MILLED

a minute of arc, as great a degree of accuracy as is necessary with milling-machine index threads.

These tables I find very useful in setting up to cut the teeth of angular cutters, as some little time is required to compute an angle by the formulas and check it over to make sure it is correct.

In the 90-degree column of each table I have included angles for all numbers of teeth. It was necessary to find them, in order to find the others, thus I included them, though one would rarely have occasion to cut a mill having a large number of teeth, with a 90-degree cutter.

HARRY C. YAEGER.

Middletown, Conn.

The annual report published by Lloyd's Register on shipbuilding in 1910 shows that the total output of the world (exclusive of warships) was 1,957,853 tons (1,857,641 steam, 100,212 sail). This is an increase of about 356,000 tons on the figures for 1909.

Discussion of Previous Question

Letters from our readers showing how many men of many minds look upon various subjects opened up in previous numbers

Civil Service Examination for Draftsmen

On page 1070, Volume 33, Part 2, was printed a list of questions to supply eligibles for ordnance draftsmen. There, S. Hurley points out that the chief criticism which comes from men who have taken the examinations and received appointments seems to be that it is more difficult than one would expect, judging from the kind of work required of the appointee. I wish to offer, not exactly criticisms on this subject, but suggestions which I think would improve the conditions from the applicant's point of view and at the same time insure the Government's obtaining well educated men, which is an essential requirement with the Government.

Under the existing conditions, what are the opportunities for the practical man against the college man in an examination, as listed on page 1070? What I mean by practical man here, is a draftsman who has achieved ability without the aid of a college education. I should say his chances for passing are very remote; but it is useless to assert that there are no practical men capable of meeting the requirements of the appointment.

It is safe to remark that any efficient, practical man would have no difficulty whatever in solving the problems as assigned by the government examinations, with the aid of technical handbooks. In solving any of such problems in industrial work the draftsman is given liberty to use a handbook. Even though he were sure of his own deductions, in the majority of cases he will consult his handbook as a matter of check on his results. Therefore, I inquire: "Why are problems assigned to be solved mentally in examinations, while it is allowable to consult a handbook industrially" It may be pointed out that the idea is to ascertain the efficiency of the applicant's education; however, I cannot see why a practical man's education is not as efficient, if he is capable of solving problems by aid of a handbook, as that of the college man, who may solve the problems mentally. Results are what are required and it does not make any difference how the results are obtained in industrial work. Why, then, cannot this rule apply to examinations?

It would be comparatively easy for a man just graduating from college to pass an examination as outlined; but for a practical man of ten or more years' experience in a drafting room, I believe he would fall down, unless he put in an unlimited amount of study just to get the exact principles by which these problems are worked out. And who would attempt to say that a practical man of this experience would be worth less to a corporation or government than one just graduating from college?

The practical man, however, would show his superiority over the college graduate on the question of drafting. Men just out of college are woefully weak in preparing a shop drawing, but with a little experience in practical work they gradually overcome this weakness. I wish it understood, however, that I do not mean to discredit a college education, because I believe a college education is the best thing in the world for a young man to begin life with; but I do mean to point out that there are just as capable men without a college education as there are with it, who would not stand the same chance as the college man would to win out in an examination of this sort.

It may also be pointed out that colleges adopt this method of examining students yearly and for entrance, but it is the aim of the college to imbed in the student's mind the principles on which such problems are solved, so that in industrial work when confronting such problems he will remember that he has worked on similar problems and can handle them more easily. However, if he does not remember the principles studied at college he has the aid of a handbook.

In civil-service examinations for post-office departments, I believe in the questions being memorized in relation to geographical locations for the reason that the applicant will be obliged to know these locations and know them quickly, should he be appointed, as his daily work will deal directly with what his examinations called for. In the drafting room, however, there is a possibility of the applicant not being assigned one problem in a year, as put forth in the examinations.

My suggestions for an examination would be to make the problems more difficult and allow the use of a technical handbook, or a printed section of a handbook dealing directly on the problem. There are, however, some questions which I think it would be to the advantage of the Government to require the applicant to know without the aid of a handbook; that is, relating to drawing, designing, materials of construction, etc.

I think all practical men will agree with me in their views on this subject, and I should like to see what the Government officials have to write in favor of their plan as well as my own suggestions on this subject.

WALTER J. BITTERLICH.

Watertown, Mass.

Jig for Holding Castle Nuts While Cutting the Slots

On page 932, Part 2, Volume 33, G. C. White describes and illustrates a jig designed for milling castle nuts and gives the time for doing this work. The time is undoubtedly a very big improvement on that required for milling the nuts singly by the older methods, and the arrangement shown is a very good example of jig work where comparatively moderate quantities only are required; however, when the product has to be put upon the market at competitive prices, and very large quantities have to be dealt with, such an arrangement is hardly a commercial proposition.

The greatest objection perhaps, from this point of view, is the necessity for handling each piece three times with the increased liability of making scrap, owing to the blanks being placed for the second or third operations upon the chips produced by the preceding operation, and a further serious objection consists in the use of the studs for locating the nuts, for the holes in a batch of nuts will vary from size to 0.005 over, and as the studs must be an easy fit in the smallest hole to facilitate assembling the nuts in the jig, and also an easy fit in the T-slot in the table, a large proportion of the nuts will necessarily be milled with the slots out of center which, in many cases, will be sufficient to cause their rejection by the inspection department, if the requirements are at all stringent.

The company with which the writer is connected mills the three slots in a 1¼-inch nut in less than 30 seconds and other sizes in proportion, and as this time compares favorably with that given by your correspondent, a short description of the method adopted may be interesting.

Owing to the high degree of accuracy required in the finished article, the nuts are handled singly, but all the slots are

milled at one setting, light milling machines of the ordinary pattern being used, the saddle and table of which are especially designed for the job.

The nuts are gripped in ordinary spring chucks similar to those used upon turret and automatic machines, a different chuck, of course, being required for each size nut. These chucks are closed by a sliding collar inclosing the usual fingers and actuated by a lever of sufficient length to make the closing easy, the whole being carried upon a special milling-machine table in such a manner as to permit the rotating and indexing for the different cuts. The mechanism for accomplishing this is carried in the saddle of the machine and consists of the usual spring-indexing bolt and turning finger, exactly similar to those used for indexing and rotating the turrets of turret lathes and the table itself slides over these and is reciprocated by a rack and pinion worked by a lever and carried by the saddle in the way commonly employed for cut-off slides.

A great variety of methods for doing this apparently simple operation have been suggested and tried, but nothing to equal the method described above either in rapidity or accuracy, has been found.

Obviously the next step is to make the whole arrangement automatic and to this end machines specially designed to deal with the job are contemplated, which will consist of cutter spindles driven in the ordinary manner and cam-operated tables, the cam shaft being driven by worm and worm wheels having a differential gear to give a fast return stroke to the table and a knockout gear to come into operation at the end of the third double stroke, bringing the table to rest when the nut is finished, each table being driven separately.

It is anticipated that one operator will be able to run two of these machines, each consisting of three spindles, and that the cost of production will therefore be reduced at least 75 per cent., so that although the cost of a machine designed on these lines may be considered somewhat high for such a job, there is no doubt but that the reduced cost of production will speedily make the outlay remunerative.

HAROLD SIBBERING.

Coventry, England.

Gear Cutting on the Keyseater

While reading Douglas Milne's gear-cutting experience on a keyseater, page 407, Volume 33, Part 2, I was reminded of a similar experience I had while working for the Nevada Engineering Works at Reno. An auto stage line on the desert, sent in an order for two 52-tooth sprockets, to fit over old 42-tooth sprockets they were using on the rear hubs. The sprockets to be made quick detachable, as they used the car for passenger car and truck alternately. The engine not being strong enough to take some of the hills where used as a truck, the sprockets were to lower the gear. The first part of the job was easy enough. The smith forged the halves with lugs for bolting together, and heavy enough to be grooved to fit over the old sprocket teeth.

We drilled through the sides left by this groove and fitted pieces to engage teeth of old sprocket when clamped on. There we were "up against it" for some way to cut the teeth. The shop has a good planer, likewise a large shaper. But the dividing head was uncertain. I finally hit on the keyseater, which was a new Baker Brothers' machine, for which the "old man" had just bought a universal table. I made the dial and pointer for the worm shaft, spaced around once to make sure, then started cutting with a formed tool the full size of tooth, which was for ⅞-inch roller chain, and finished the teeth without roughing.

Butte, Mont. R. M. MCGREW.

Making a Radius Forming Tool

On page 264 is an article by B. N. Birmingham on making a radius-forming tool.

It would be impossible to make an accurate radius-forming tool by any of the methods he mentions.

I would suggest if one wishes a forming tool to the exact radius of the boring bar, mill or reamer, which he mentions using, that he clamp his tool square with the centers of the lathes and set the taper attachment to the angle desired for clearance, and then proceed as recommended by Mr. Birmingham.

New Britain, Conn. FRED P. GATES.

The Cast Iron Box

Professor Sweet favored the readers of the AMERICAN MACHINIST, on page 183 with a short article entitled "Is the Bronze Box a Good or a Bad Thing." This, like others of Professor Sweet's communications, has brought out several interesting remarks from other correspondents, most of whom have spoken highly of the advantages of cast iron as a bearing metal. When cast iron is kept properly oiled I doubt if there can be found a better material for such purposes.

All bearings should be suitably lubricated and because babbitt metal will stand abuse far better than cast iron it is too often given the preference. Yet who can ask for a better surface than can be seen on the V's of a planer? A short while ago I examined the spindle and bearings of a speed lathe. It had been in continuous service for 20 years and had then been sent to the makers to have some fixtures applied. Advantage was taken of this to examine the bearings. The lathe was in excellent condition and the construction was somewhat peculiar. The spindle had at the front bearing a sleeve of cast iron shrunk on and this ran in a bronze box. After all these years the cast iron was entirely free from scratches and was bright like silver. The bronze box was smooth and also free from scratches and no one could ask for a better running lathe.

I have noticed when inspecting machinery that it is usual to find bearings that are oiled to be more or less injured by scratches, while bearings in the same machine that were lubricated with grease cups were uniformly in good condition and free from these injurious markings. Yet I have yet to see a lathe spindle bearing provided with compression grease cups.

Will Professor Sweet tell us something about the best form and materials for the front bearing of an engine lathe of moderate dimensions, say one carrying a faceplate 16 inches in diameter? With the numerous forms of the front bearing of the spindle one may conclude that a perfect bearing has not yet been made. What some of us would like to know is what are the best conditions of a front spindle bearing of a good lathe.

We have a little coterie of mechanics in this city and there may be such elsewhere where this question has often arisen and we are well satisfied that Professor Sweet could give us the desired information.

CLARENCE STERLING.

Bridgeport, Conn.

Arrangement of Easy Movement of Large Tailstocks

The device described by W. R. Oakes under the above title, on page 217, Vol. 34, is not new, as I recall to mind a very similar but more simple one. Instead of two eccentric shafts and four rollers, the device I have in mind, which is used by the Putnam Machine Co., Fitchburg, Mass., on their large lathes, has but one shaft and two rollers. The shaft was located at about the balancing point of the tailstock, with just enough throw to it to raise the tailstock by a half turn, in which position it remained without locking and enabled the operator to move the tailstock freely either way.

J. D. D.

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Contents

PAGE

Electric Arc Welding Processes..... 479
Dipping Drawing Stand Parts..... 486
Re-expanding Condenser Tubes..... 487
Taxes on Commercial Travelers Abroad 488
Micrometer for Fine Measurement..... 489
Cost Accounting by Machinery..... 490
A New Method of Tinning and Galvanizing 493
Live Tailstock Centers, Electric Hardening and Some Other Things..... 494
Four Belgian Machine Tools..... 495
Jig for Gas Engine Pipe Connections... 498
Elastic Rebound in Wire Tension Tests 498
Reel for Coiling Wire Cable..... 499
Cutting Off by Grinding..... 499
A Scraping Machine and Some Tools.... 500
Anti-Tipping Pulley T-Square..... 501
Estimator, Rate Fixer and Inspector.... 502
Letters from Practical Men:
Boring Thrust Blocks.... Reinforced Wrench Jaws for Abnormal Strain....Grinding a Cupping Tool ....Charting the Movements of a Machine.... Scribing Outline for Bending Punch.... Turning Hardened Steel.... Adjustable Spring Winder....Handling Long Tracings on Small Boards....Truing Up Deep Holes.... Setting Angles to Mill Teeth in Angular Cutters.....505-508
Discussion of Previous Question:
Civil Service Examination for Draftsmen.... Jig for Holding Castle Nuts While Cutting the Slots ....Gear Cutting on the Keyseater ....Making a Radius Forming Tool ....The Cast Iron Box....Arrangement of Easy Movement of Large Tailstocks 509-510
Handling Materials and Machinery..... 511
Coöperation between Buyer and Seller... 511
Why Not Place Railroads on a Manufacturing Basis?..... 511
The Cost of Smoke in Cities..... 512
Castings of Monel Metal..... 513
The Life of a Patent..... 514
Shop Equipment News..... 515

American Machinist

Handling Materials and Machinery

In spite of the many and strenuous efforts which are made, from time to time, to systematize manufacturing establishments and to reduce the cost of production, it is almost impossible to go in the average shops without being impressed with the opportunities for reducing the cost of handling material to a considerable extent.

Work from the screw machine will be tossed promiscuously into barrels or boxes, so that it must be handled many times between the start and finish of its journey through the shop. Larger work is piled on the shop floor and must be moved from here to other departments either by hand or by being loaded on trucks and again unloaded at the other end.

Heavy machines are moved from place to place by rollers under the skids, coupled with a liberal use of crowbars and profanity. This is particularly true of machinery salesrooms, many of which sell cranes and conveying machinery. The cost of loading and unloading machines from drays in the usual way is a much larger item than we might be willing to believe if we looked into the matter carefully.

Some shops where this has been considered to some extent, make it a point to have the product of any machine placed directly on a substantial shop truck so that it can go to the next department without further handling or delay. This is done either in boxes or in racks, according to the nature of the work, but in either case there is a distinct gain in time over the other method. There is also likely to be much less damage to the work itself, and, besides reducing the actual handling cost, it avoids delay between departments which is not only exasperating but also expensive.

Co-operation Between Buyer and Seller

At a recent machine-shop session of the annual meeting of the American Society of Mechanical Engineers, several speakers emphasized the necessity of co-operation between buyer and seller of machine tools, provided the best results are to be obtained. No argument is needed to show the soundness of this contention, but persuasion is necessary to stimulate action. The path of least resistance is to write letters asking a quotation on a machine tool and a guarantee of its production for a certain class of work. If the machine and kind of work are well known in the shop making the inquiry, all well and good; but if the work is somewhat out of the ordinary and the machine is highly specialized, it is far better for prospective buyer and machinery manufacturer to get together.

Experience gained from many former sales, from the records of many machines in successful use, places the manufacturer in such a position that he can intelligently recommend ways and means to do the work under consideration and give the prospective customer a starting point from which he can build up his own experience.

On the other hand, it is probable that the very best of results can only be obtained by the user after careful systematic study of his own problems. The machinery builder can give him a starting point, a point a long way along the road leading to success. But that starting point comes from a brief consideration of the problem on the part of the manufacturer, while on the part of the user the problem is one that is with him every day and out of which he is probably getting his bread and butter. Thus the incentive is all the stronger, the opportunity all the greater, for him to better the results obtained from the manufacturer's experience and forming his starting point.

The same principle holds here as in the field of invention and design. Much unnecessary duplicating experimental work can be avoided if one would take the trouble to find out what has been done and the results that have been obtained. Therefore let us have more real co-operation between the user of special machine tools and the maker thereof, in order that each may benefit by the experience of the other.

Why Not Place Railroads on a Manufacturing Basis

Some of our machine-building friends are fearful lest the recent decision of the Interstate Commerce Commission in regard to railroad rates deter the buying of new machinery. In fact some point to the reported cancelation of orders for locomotives and other equipment as evidence of this.

Much of this is probably newspaper talk, but a little study may throw a different light on the case.

New equipment for either a shop or a railroad is only ordered when it is supposed to be necessary, and able to do the work more economically than can be done with the old equipment. This is

the only condition on which the purchase of new equipment can be justified, even when it is replacing worn-out machinery that can no longer be used.

It will hardly be argued that an increase in freight rates would add to the amount of freight to be hauled, so that the orders for equipment which are reported to have been canceled, were not ordered because they were needed, or else their cancelation is a simple club to influence public opinion. In fact, even had the rates been lowered, there is all the more need of the most economical machinery to reduce the cost of doing the work.

When a manufacturer finds that through competition, increased labor cost, or for any other reason, the cost of production must be reduced, he does not cancel his orders for new machinery, but orders more and the best he can buy. And this he usually does from his own earnings and does not issue stock or bonds every time he needs a new building or a new machine.

As the decision does not reduce the rates or the earnings of the railroads, which have paid good dividends during the not over-prosperous years of 1909 and 1910, it is very evident that the only adverse effect is on the speculative value of the stock, as it may prevent any "melon cutting" in the near future.

But it must be very evident by comparing the manufacture of transportation facilities with that of any other commodity that the way to increase earnings is to buy the best possible machinery instead of canceling orders which have already been placed.

The sooner railroading is placed on a manufacturing instead of a speculative basis, the better for all concerned.

The Cost of Smoke in Cities

We have become accustomed to coupling large quantities of black smoke with manufacturing progress, even to always picturing our shop chimneys belching forth great volumes, that we are apt to overlook the other side of the question. For there is another side, and not entirely the esthetic point of view either, but a cold business proposition of actual cost in dollars and cents.

Business men in both Cleveland and Chicago have given as a conservative estimate that the actual cost of smoke to their cities amounts to more than the tax annually collected to run the cities.

Aside from the havoc played with any beauty that buildings may possess, the cost of constant cleaning of buildings, of carpets, furniture and clothes; the loss in drygoods each year, the supporting of double the number of cleansing establishments per thousand inhabitants than eastern cities, make it a factor to be reckoned with.

The burden affects everyone within reach of the smoke and adds a definite amount to the cost of living, as well as having its direct effect on the cleanliness and consequently, the health of the community.

Soft coal must be burned, probably for both domestic and factory purposes, and it is practically impossible to burn it without more or less of the smoke. Yet much of the smoke can undoubtedly be prevented, and it is worth money to have it done.

Many claims have been made as to the fuel economy of smoke prevention, but it is worth doing even if it costs more.

The cities could well afford to make a substantial reduction in the taxes of such factories as did away with the smoke nuisance, thus making it a direct object to the manufacturer and rendering it even more attractive by contrast with the usual fine when an undue amount of smoke is allowed to be made.

This is a live subject for every town or city, and for every class of manufacturer. Smoke is a direct detriment to any community and all should coöperate toward its abatement both by careful firing and by the use of such apparatus as will assist combustion.

New Publication

Shop Kinks. By Robert Grimshaw. Three hundred and ninety-three 4½x7¾-inch pages; 224 illustrations in the text; indexed. The Norman W. Henley Publishing Company, New York City. Price, $2.50.

This fifth edition needs but little comment by way of review, for the former editions have rendered the work well known in the machine-shop field. The book brings together a large number of shop hints, kinks and wrinkles, described in a clear, easily read style, and arranged with the purpose of being of value to the man in the shop.

Metal Trade Meetings

The annual meeting of the Rhode Island branch of the National Metal Trades Association, was held on March 2 at the Narragansett hotel, in Providence. The officers for the ensuing year are: E. A. Beaman, president; A. J. Thornley, vice-president, and J. G. Aldrich, treasurer. The meeting was addressed by A. Parker Nevin, of the general council for the National Association of Manufacturers, and Dr. Wm. J. H. Boetcker, secretary of the Citizens Industrial Association.

The Boston branch of the National Metal Trades Association held a meeting on March 1, and in addition to the regular routine, the following officers were elected for the coming year: President, Winslow Blanchard; vice-president, H. I. Illingworth; treasurer, D. D. Russell; executive committee, F. F. Stockwell and W. S. Martin.

Personals

Frank M. Chandler, for some time secretary of the New Haven branch of the National Metal Trades Association, has resigned in order to engage in a new line of work.

William B. Cowles, until recently vice-president and treasurer of the Long Arm System Company, Cleveland, Ohio, has established an office in Detroit, Mich., as industrial expert and consulting engineer.

Milton W. Hogle has accepted the position of works manager of the T. H. Symington Company, Rochester, N. Y. Mr. Hogle was formerly chief test engineer of the Indiana Steel Company, Gary, Indiana.

Charles H. Bigelow, formerly on the engineering staff of Charles T. Main, Boston, Mass., has accepted the position of assistant superintendent of the Yale & Towne Manufacturing Company, Stamford, Connecticut.

Max Rotter, who has been chief engineer of the Allis-Chalmers Company for several years, has accepted a similar position in the newly organized Busch-Sulzer Brothers-Diesel Engine Company, St. Louis, Missouri.

Carl Falk, who was formerly sales manager for the Herman Pneumatic Machine Company, has become connected with the Mumford Molding Machine Company, New York City, and will have his headquarters in Buffalo, N. Y.

Alfred F. Howe, vice-president of the Borden company, sails for Europe today for a two months' trip in the interests of his company, and while abroad will make his headquarters at the London and Berlin offices of the American Machinist.

Aldrich Durant, who until recently was superintendent with the Turner Construction Company, has become connected with MacArthur-Perks & Co., to act in the capacity of engineer in charge of the work of building four piers in the harbor of Havana.

Fred. W. Derbyshire has resigned as superintendent of the American Watch Tool Company, Waltham, Mass., in order to organize a business of his own, with a factory at 155-157 High street, Waltham, Mass. He is to manufacture a line of watchmakers' lathes and attachments.

Robert L. Windholz, who has for several years been vice-president of the Vandyck Churchill Company, has resigned from the above company and will shortly open an office in New York City, acting as special eastern representative for several prominent machine-tool manufacturers.

Castings of Monel Metal

By S. B. Redfield

Unusual characteristics of a metal, which is a natural alloy obtained by reduction of an ore which is found in the mixed state.

The castings have the strength and many other properties of cast steel, while they have greater resistance to corrosion from sea water, superheated steam and some chemicals than the bronzes.

Until recently, builders of ships and marine machinery have resorted to various kinds of bronzes for those metal parts which are called upon to withstand the corrosive action of sea water. There is, however, a metal upon the market which it is claimed has even greater resistance to corrosion than any of the bronzes, and furthermore has the strength and many of the other properties of cast steel. It also may be forged, soldered and autogenously welded. This metal is Monel metal and castings of it are made at the plant of the Bayonne Casting Company, Bayonne, N. J.

Monel metal is a natural alloy; that is, it is produced from an ore which is a mixture of the ores of nickel and copper. When this mixed ore, as it occurs in nature, is reduced to metal it forms an alloy containing 67 per cent. nickel, 27 per cent. copper, and 6 per cent. of other metals, including iron and manganese. In appearance this metal resembles nickel, being bright and taking a polish almost equal to that of silver. Its tensile strength usually is above 70,000 pounds per square inch in the casting, with a yield point of over 35,000 pounds per square inch. The elongation in two inches is around 28 per cent., and the reduction in area about 35 per cent. It machines with about the same ease as machine steel.

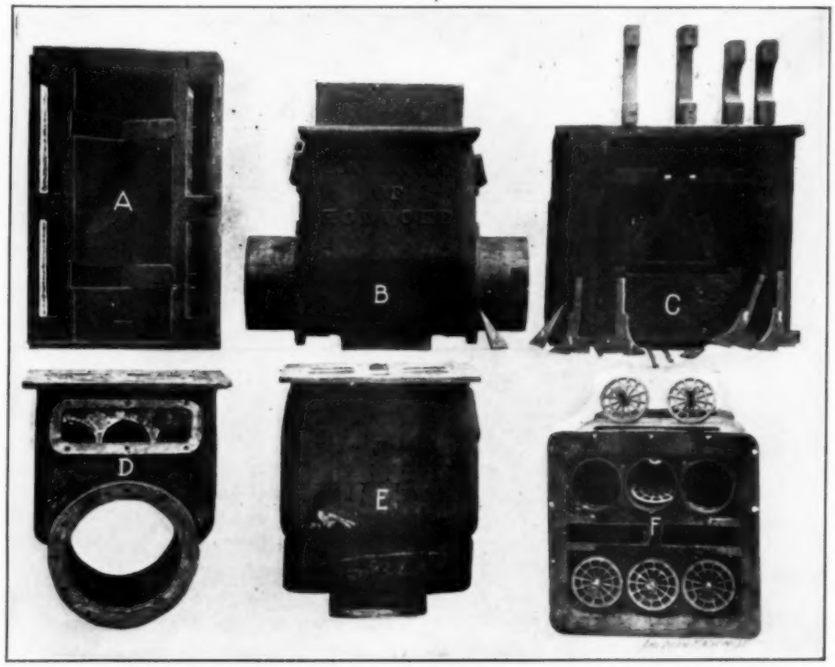


FIG. 1. PATTERN, CORE BOXES AND CASTINGS OF MONEL METAL PUMP CYLINDER TO HANDLE SALT WATER IN NEW YORK HARBOR

USES OF THE METAL

Owing to its remarkable ability to withstand the corrosion of sea water, the Government is now equipping its battleships with propellers of this material, these being cast in single pieces. Fig. 4 shows two of the rough castings of propellers for the battleship "Florida," these being nearly 11 feet in diameter. Similar propellers also were made for the "North Dakota" and for battleships of various other countries, some of these being 15 feet 6 inches diameter in a single piece, weighing 16,000 pounds. After 18 months' service it is said that the wear and corrosion of these propellers was found to be practically negligible, and it is further found that they resist bending to such an extent that they are not so subject to loss of efficiency as propellers which yield under the heavy backward pressure against the water. Stiffness is considered to be the explanation of this fact, because the modulus of elasticity of Monel metal is between 22,000,000 and 23,000,000. Manganese bronze has a modulus of elasticity of 13,000,000, and steel between 28,000,000 and 32,000,000.

As might be supposed, this metal is being used for cylinders of pumps handling salt water, and in some cases chemicals which would corrode the metals ordinarily employed. Fig. 1 shows the patterns, core boxes and casting of a 16x18-inch pump cylinder to handle salt water from New York bay, in connection with a jet condenser. Referring to this illustration, *A* is the core box for the pump barrel, the two loose pieces forming prints for cores from the water chamber shown in the core box *C*. *B* is the pattern for the cylinder and, as intimated, *C* is the core box for the water passages and valve chambers, the prints being seen for the cores which pass through the valve openings. *D* is an end view of the outside of the casting and through the upper, elongated hand hole may be seen portions of the three round valve passages over which set the grids to carry the valves, as seen in *F*. *E* is, of course, an outside view of the casting.

AEROPLANE PARTS

In Fig. 2 may be seen something which is distinctly modern; that is, castings for the connection pieces of aëroplanes. When it is considered that these parts are noncorrodible and that they carry the strength of cast steel, the applicability of this material to this purpose will be appreciated. Various parts, such as valve grids, and especially fittings for carrying superheated steam, as well as runners for blowers to carry corroding gases in chemical establishments, are seen in Fig. 3. This ability to withstand the action of superheated steam is another point claimed in favor of Monel metal. The two large rings at the center and in front of Fig. 3 are for the framing of port holes for a ship.

METHODS OF MELTING THE METAL

In the melting of this metal, which, by the way, takes place at no less a temperature than 2480 degrees Fahrenheit, it is essential to avoid oxidation as much as possible. For this reason the pigs of this metal are melted in a special, oil-burning reverberatory furnace. The peculiarity of this, however, is in the fact that the oil is fed by gravity and there is no forced air blast. The draft is entirely natural, due to a stack, and the oil is burned on special trays over which it

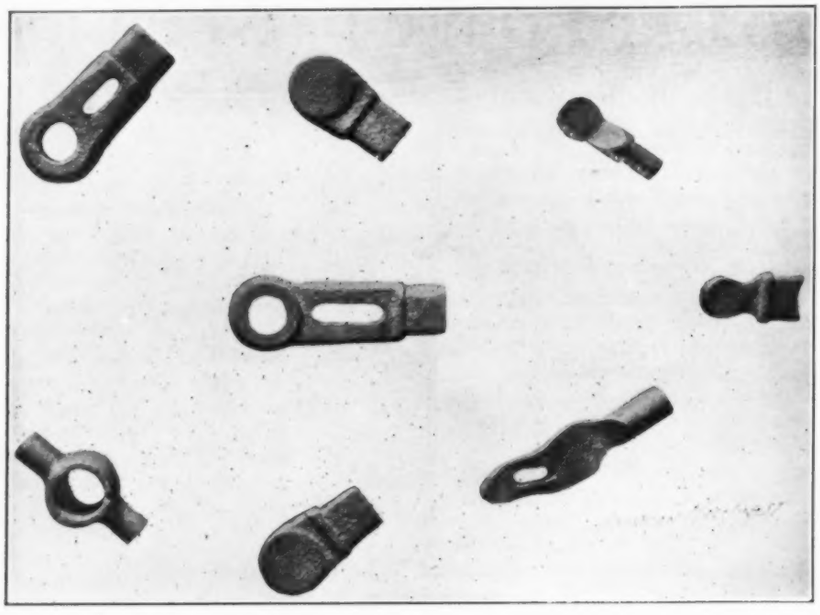


FIG. 2. ROUGH CASTINGS OF CONNECTION PIECES FOR AEROPLANES

flows. This and many other points in the manipulation of this metal are taken directly from the practice of handling and melting nickel. Indeed, it is said that the operators who do this work are essentially expert nickel men.

PROPELLER MOLDS

In the casting of the propellers the practice is to make a pattern including one blade and one-third of the hub. This is mounted on a suitable vertical spindle held in the foundry floor, and a loam mold built up under the pattern blade. This being completed and the pattern buried even with its top curved surface, the pattern is lifted and swung around the spindle to the position of the next blade and a new loam mold built up under it. After this, separate iron copes, one for each blade, cast especially for the purpose both as to curvature and outside shape, are placed over the blade molds. The three copes fit together and form the upper portion of the central boss. On smaller sizes for motor boats it is the practice to make a master pattern of a single blade in wood, and from this a lead casting is made which in turn is used as the pattern for making the final wheel in Monel metal. The object of this is to have a pattern whose pitch may be readily changed by bending.

The weight of a cubic inch of cast Monel metal is 0.319 pound, cast iron weighing 0.26 pound per cubic inch.

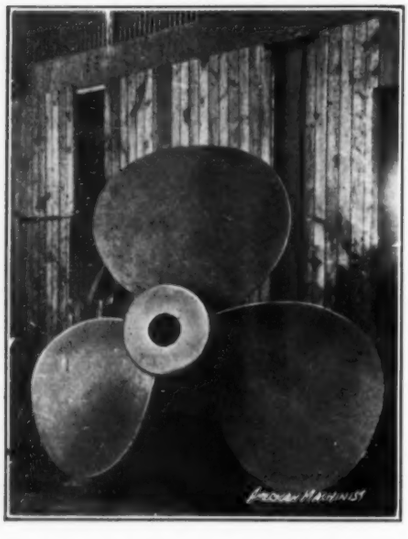


FIG. 4. CASTING OF PROPELLER FOR BATTLESHIP "FLORIDA"

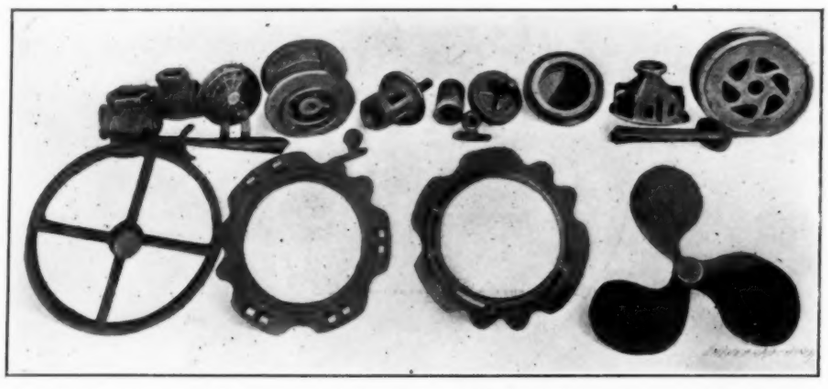


FIG. 3. CASTINGS OF FITTINGS TO RESIST SEA WATER, SUPERHEATED STEAM AND CHEMICAL FUMES

The Life of a Patent

BY IRVING D. KIMBALL

It is commonly understood that the statutory term of a United States patent is 17 years. There are exceptions to this rule and it is sometimes possible when this is understood to take advantage of the fact and use the invention before the end of the 17-year period.

Prior to January 1, 1898, there was a law upon the statute books of the United States which provided that a patent granted in this country, the invention of which had been previously patented abroad, should expire at the same time as the foreign patent and if there were more than one foreign patent it should expire with the one having the shortest term.

Thus, for example, suppose an application for patent was filed in England in March, 1897, and a United States patent for the same invention was granted in October, 1897. The United States patent would expire in March, 1911, instead of October, 1914, as the British law provides for a term of 14 years from the date of application.

This United States law was repealed by Congress in 1897, the repeal taking effect on January 1, 1898. The act which repealed the old law provided, however, that the repeal should not apply to patents granted prior to January 1, 1898, nor to any patents granted on applications filed prior to that date.

Thus it will be seen that a United States patent resulting from an application filed in 1897 the invention of which had been patented in England in 1893 would have expired in 1910, even though the United States application had dragged along in the Patent Office and not granted until 1905.

Usually such a United States patent will show in its heading that it has been patented abroad and a comparison of the dates will give the information desired.

When a patent is reissued it constitutes another exception to the general rule as the reissue does not run for 17 years from its date but expires at the same time as the original patent, that is, 17 years from the date the original was granted.

Knowledge of these facts will sometimes allow the use of inventions which have been patented when at first glance a person would have the impression that they could not be used for a number of years.

Shop Equipment News

American Radial Drill with Speed Box

The halftone shows the new 8-speed box as applied to 4-, 5-, 6- and 7-foot plain and full universal triple geared radial drills built by the American Tool Works Company, Cincinnati, Ohio.

This new speed box will transmit enough power to enable a 6-foot radial to pull an 8-inch pipe tap.

It is of cone and tumbler construction and provides 8 changes of speed, each one of which is instantly obtained by shifting the tumbler lever. The speeds are obtained through the medium of four change gears on the lower shaft and three gears on the tumbler, which is of the compound type.

All driving gears are of special steel carbonized and hardened and are of the Brown & Sharpe 20-degree involute pointed tooth type. With this construction all tendency of the gears to "ride" is eliminated and furthermore the gears can be meshed without shock or damage.

The tumbler lever is located in its various positions by a notched plate which prevents the gears from being improperly engaged. After the tumbler is located it is securely locked in position by a latch pin.

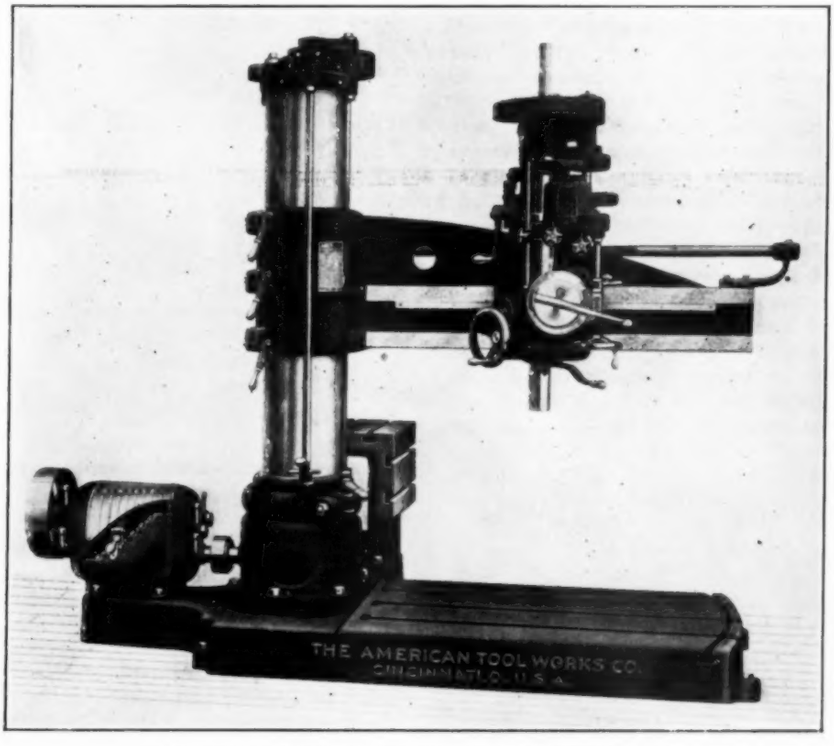
ANY and all new or improved machines, tools or shop appliances of interest to men responsible for results in machinery-making plants will be briefly illustrated and described here — the machine shop news.
A more full and detailed description will be given — when it is real news — if it can appear here first — before it is sent to other papers. ALL descriptions appear in ALL four editions of the paper—Weekly, Monthly, Weekly English and Weekly German

The speeds may be easily changed without shock as the cone gears are kept rotating while changing speeds. This is accomplished by means of an auxiliary drive (between the pulley and cone shaft) which is automatically engaged and disengaged by the raising and lowering of the tumbler lever when changing from one speed to another. This auxiliary drive is positive in its action. It operates through a friction clutch which may be adjusted as required. This feature is used only when changing speeds.

A shock absorber in the line of drive absorbs all shocks and strains and thus insures long life to the driving mechanism.

This style of box is interchangeable with the 4-step cone pulley regularly furnished and also with the 4-speed friction type of speed box.

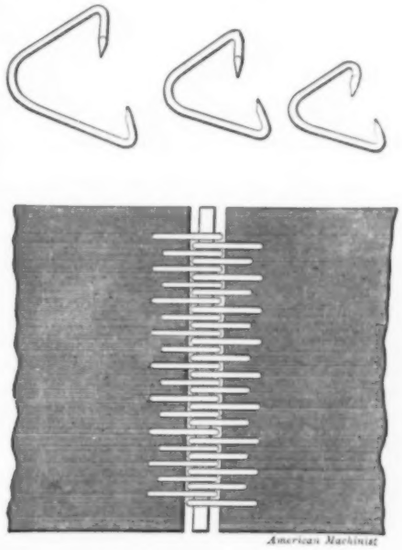
An "American" Radial equipped with this speed box can readily be converted into a motor-driven machine at any time.



AMERICAN RADIAL DRILL WITH EIGHT-SPEED BOX

A Belt Fastener

The fastener consists of the belt hooks, and the rawhide pin used for joinjoining the two belt ends, in the place of which hemp may be employed. To insert the hooks into a belt they are arranged in a row on a holding strip with a wooden pin thrust through them. This pin prevents the individual hooks from dropping out. This strip is inserted into a hand press and the hooks forced into the belt and clinched.



BELT HOOKS AND A FINISHED JOINT

After these hooks are inserted in the belt end, the wooden pin is removed and the holding strip is torn off.

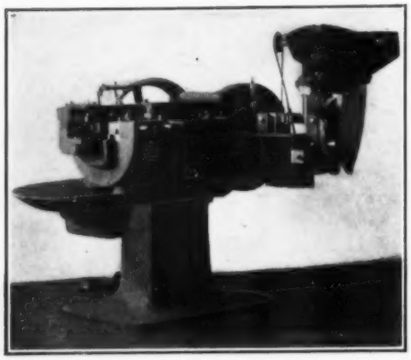
In an emergency the hooks may be driven into the belt with a hammer, us-

ing the surface of the belt pulley as an anvil. As the hooks are made of round steel wire, they engage with each other hinge fashion.

These hooks are made in three different sizes and furnished on strips up to 150 millimeters wide (6 inches), by C. Matthaei, Offenbach, a.M., Germany.

A Thread Rolling Machine

The halftone shows a thread-rolling machine built by the Waterbury Farrel Foundry and Machine Company, Waterbury, Conn. The machine shown is equipped with hopper feed which can



A Thread-rolling Machine

readily be swung out of the way of the operator should it, for any reason, be desired to feed the work to the dies by hand.

The machines are made in seven sizes to take work from ⅛ to 1 inch diameter. The smallest machine makes 85 strokes per minute while the largest size runs at 30 strokes per minute.

A Pipe Cutting Tool

The halftones show a new tool for cutting pipe in the lathe, which has been brought out by the Taylor-Wilson Manufacturing Company, McKees Rocks, Penn.

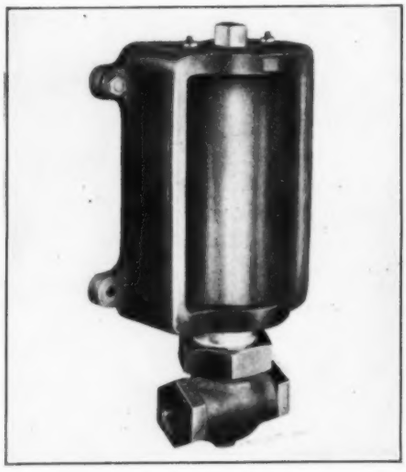
The cutting blade is fastened to the body by means of two screws, and a steel disk, which is located at a suitable angle above the cutting line, is adjustably mounted on the frame to allow for the various sizes of tubing that this tool will cut. This disk nicks the pipe and also prevents the tool from entering the cut too rapidly.

This tool may be used at almost any distance from the chuck, thereby doing away with the necessity for a steady rest or support for the work.

The tool is designed to cut pipe or tubing from ⅜ to 12 inches diameter.

Solenoid Operated Valve

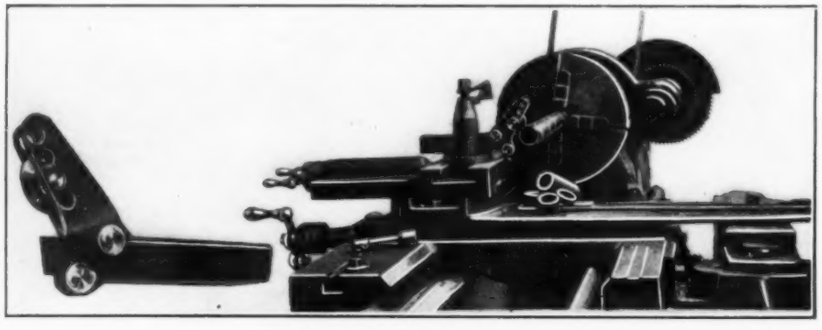
The accompanying halftone shows a new solenoid-operated valve, recently developed by the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis. The primary object of this valve is for



A Solenoid-operated Valve

the unloading, or removal of pressure from an air compressor when being started up, presumably automatically, by an electric motor, so as to cut down the heavy initial inrush of electric current required to overcome the compression of the air during the period of getting up to speed. The arrangement consists of a bypass valve automatically operated by an electric solenoid properly connected to the electric starting apparatus.

This device is suitable also for remote control of other apparatus and is made in four standard sizes, ⅜, ½, ¾ and 1 inch. Solenoid coils may be furnished for voltages of 115, 230 and 500.



The Tool and Its Use

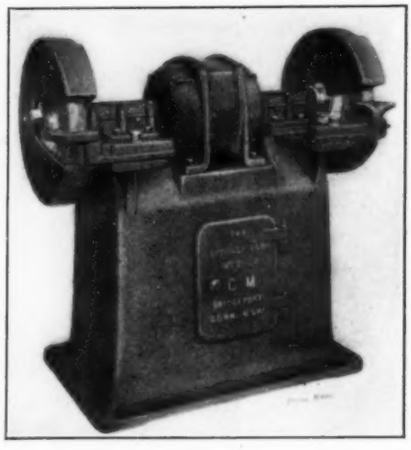
Polyphase Induction Motors

The Crocker-Wheeler Company, of Ampere, N. J., is introducing a new line of polyphase induction motors. The simplicity of this type of motor makes it practically "fool proof," and the possibility of using these motors in connection with a high-tension transmission system has contributed materially in reducing the cost of delivered power.

In textile mills, woodworking plants and other places where a small spark may easily cause an explosion or dangerous conflagration, squirrel-cage induction motors may be used with safety, as their construction involves no sliding contacts.

Motor Driven Dry Grinder

The halftone herewith shows one of the new, direct-connected motor-driven dry grinders, manufactured by the Springfield Manufacturing Company, Bridgeport, Conn. It will be noticed that on this machine the motor is practically all inclosed and mounted on a very heavy and substan-



Motor-driven Dry Grinder

tial base so as to absorb vibration as much as possible. The machine is equipped with large and long bearings, which run in self-oiled boxes.

This type of machine is made in three sizes, carrying wheels 12x2, 18x2 and 24x3 inches, but is capable of carrying wider-faced wheels if desired. It is also made either with or without safety hoods.

A New Alloy, Duralumin

This alloy contains about ½ per cent. magnesium; 3½ to 5½ per cent. copper; ½ to $\frac{*}{16}$ per cent. manganese, and over 90 per cent. pure aluminum. These may be varied according to the purpose. The specific gravity ranges between 2.75 and 2.84 (as against 2.58 for aluminum). The melting point is about 650 degrees Centigrade. The electrical resistance is greater than that of pure aluminum.

Duralumin is hardened in the same manner as steel, both the strength and hardness being increased by heating and cooling. If it be desired to give a somewhat greater ductility at the expense of strength and hardness, it can also be annealed.

Duralumin is used where a light weight in proportion to strength is desirable. It will stand the atmosphere; fresh and salt water, sulphuric acid, nitric acid, quicksilver, etc., have little effect on it, although it is attacked by hydrochloric acid and alkalies. It takes a high polish which is very durable, and which saves nickel plating if not intended for use in contact with destructive material, such as soda when it is employed for cooking utensils, etc.

It can be galvanized and soldered; however, any solder containing tin, zinc, or other substance which excites electrical tension with Duralumin cannot be considered advisable.

It can be welded but the heating attendant on soldering and welding is, however, somewhat injurious to the strength of the joints. When it is possible to subject them to an after treatment, and perhaps to a mechanical reworking, this can in part be remedied. Experiments along this line are now taking place.

Duralumin is recommended for military equipment, especially in light expeditionary service, for almost all parts now made of iron or wood. For aëroplane construction, it should possess value.

The alloy is made into rods, sheets, wire, hoops, shapes, billets, forged pieces, etc.; but it is not ordinarily employed for casting purposes.

It is handled in this country by the Electric Boat Company, 11 Pine street, New York.

Trade with China and Korea

Editorial Correspondence

On Wednesday afternoon, March 8, was held the seventh of the export trade talks of the National Association of Manufacturers at their home office in New York City. The speakers were Durand C. Alexander and Charles Loeber and the countries considered were China, Manchuria and Korea.

Mr. Alexander has spent several years in China and Manchuria as a special representative of the Nicholson File Company, thus he is thoroughly familiar with Chinese trade conditions and with the best methods of introducing American goods into that market.

In his remarks he said that the loss of American trade during last year over the year preceding, in amount some eight and one-half million taels ($5,500,000), was not as serious a loss as appears on the surface. Analysis shows that this loss was in three commodities—flour, lumber and kerosene. It is hardly to be supposed that we can export flour when wheat is selling for $1 per bushel. Lumber is steadily advancing in price in this country, which must inevitably cut down the amount exported and the increase of gas plants and electric-light plants throughout China and Manchuria must have some influence on the amount of kerosene consumed. The present feeling in China toward America and Americans is much better than it was a few years ago, at the time of, and immediately following the American boycott. The influence of that boycott is not now felt except in some places in the interior. There is undoubtedly a fine opportunity today to trade with China.

In considering the method of getting trade in that country and articles adapted to those markets, one must not forget that labor there is extremely cheap. So cheap, in fact, that automatic labor-saving machinery has no field. In addition to the cheapness of Chinese labor, the workmen are good artisans, and with their crude methods produce some splendid products.

To illustrate this point, Mr. Alexander told of visiting one section where a great deal of lumber was sawed, believing that there should be a field for American files in the sawmills. The place was new and had only been opened a few months as a treaty port, but much to his surprise he found a number of blacksmiths' shops along the principal street, engaged in making by hand a peculiarly designed file. These files were sold for 15 cents each; were of good quality, adapted for the work for which they were intended, and it was very evident that American files could not compete.

The sending out of a capable traveling salesman is an excellent way to enter the field. Such a man should be technically trained, fully acquainted with his product, a good mixer and not too much of a hustler. A first trip should be looked upon as laying a foundation rather than a means to get immediate results.

The market for machinery requires machine tools, gasolene engines, pumps and electric-lighting apparatus. These are now handled as a rule by European firms, as there are but few American houses established in China.

Qualities Needed in a Traveling Salesman

If a firm is seriously considering entering the China field, it is best to send out a traveling salesman. Such a man should be technically trained, very familiar with the goods he is to represent, a good mixer, for he must spend considerable of his time in the clubs, and it is better if he is not too much of a hustler. The Chinese do not understand our hustling ways and do not like them. A first trip should be looked upon as laying a foundation for business growth, and should be expected to pay more in future returns than in immediate results.

Acquaintanceship in China is worth even more than in this country in selling goods. When a traveling salesman enters a section he should at once get acquainted with the American Consul, with the manager of the American bank, if one exists, and then reach out to the native merchants. These merchants are usually very courteous, and if approached in a proper manner will frequently show samples of the goods they are handling and their invoices. This gives the traveling salesman a first-hand knowledge of the grade of goods that they use and of the prices that they pay.

The actual business is usually done with the commission houses, and as a general rule it is not safe to give credit to native merchants. The collections are usually made through a 60- or 90-day draft, accompanying the bill of lading, to which interest at the rate of 6 per cent. per annum is added. Before the commission house can get its bill of lading for the goods, it must pay the sight draft. Usually 2 per cent. cash discount is given in order to offset the interest that the commission houses pays.

It is very common to give buying commissions of 2½ per cent., a business method that is, of course, appreciated by a commission house.

Fair business methods are as important here as with any other country. Promises should be kept. If mistakes occur in a shipment they should be rectified at once without question. It is wise to remember that it takes a month for a letter to get from New York to China, and another month for an answer to be returned, thus in all correspondence detail and accuracy are essential.

An Important Warning

A warning, which may be difficult for the traveling salesman to heed is "Don't oversell a given market." Rather than sell a bill of goods to every merchant in a given locality, it is better to sell to a few and then tell the others to purchase from those who have given orders. If every merchant is sold, the amount of goods received at the same time may be too great to be readily absorbed, thus a part of it will become dead stock and may have to be sold at a loss. This naturally creates prejudice toward that particular brand of goods.

An essential part of the outfit of a traveling salesman is a complete line of samples. It is not wise to show a few samples and attempt to explain the differences of other associated lines of goods. The Chinese merchant wants to see exactly what he is buying, and the word exactly is used in its broadest sense. The samples shown must be the exact counterpart of the goods to be furnished, both in quality, size, shape, color, markings, and in fact all particulars.

Trade marks are of great value; that is, after they have become known and established. To introduce your goods and establish your own mark, or chop, missionary work is absolutely essential.

In case machinery is being exploited a working exhibit is of great value.

On most of the railroads of China the engineers are English, and for this reason they purchase many English tools, yet there are a great many native engineers who have been educated in America and they are very favorably disposed to American products. Catalogs are of great value; that is, if they are printed in Chinese. Such things are not common throughout China, and a well prepared catalog is usually kept and frequently referred to.

But little advertising is done, although a few houses print a Chinese calendar, which is an elaborate, many-colored production. These are eagerly sought for and may frequently be seen adorning the walls of offices.

In order to get business without sending a traveling salesman, it is wise to get from American consuls in treaty ports or from other authoritative sources, lists of importing firms who might be interested in the lines which it is wished to introduce. The matter can then be taken up by correspondence, taking care, as mentioned above, to make this very explicit and accurate.

It is important to remember that it now takes from three to four months to get a shipment from eastern America into China, that is, by way of the Suez canal. After the opening of the Panama canal, this time will be shortened, and this will be directly to our advantage.

The question of exchange with China is very important. If exchange is rising, merchants will usually buy freely and on the other hand, if exchange is falling, they will be inclined to wait for a change in business conditions. This situation will be different if China adopts a gold standard, and a movement is now shaping itself in this direction, under American influence.

Need of Missionary Work

Mr. Loeber has spent some three years in Korea, dealing with interior conditions, rather than with those of the treaty ports.

He dwelt in particular upon the need of missionary work in introducing small tools and common necessities into that country. In some of his own work in the building trade he has introduced American woodworking tools, such as chisels, planes and bits, and as soon as the demonstration was made to the native worker that he could produce more work in a given length of time, he was eager to have these tools in his own kit. In bricklaying a similar experience has been met with, and Philadelphia pattern trowels are now used in the particular section in which Mr. Loeber lived.

Gas, electricity, heating plants and bath rooms are beginning to be installed in the homes of the well-to-do. There is an excellent field in furnishing apparatus of this nature. Once a foothold has been obtained, it is easy to make successive sales on the strength of a former one. If a man provides his house with a heating plant, the same aid to comfort is, of course, desired by his next-door neighbor.

The need of missionary work cannot be over emphasized and working exhibits are of great value.

In speaking of internal conditions, Mr. Loeber stated that he has found traveling to be perfectly safe and has never been molested, although he has traveled extensively through the interior of Korea and Manchuria, and has frequently been accompanied by his family.

Electricity in Agriculture and Horticulture

In an address before the Southern Commercial Congress held at Atlanta recently, George Westinghouse, referring to the future of electricity, touched upon its use in agriculture and horticulture as follows:

In 1906-7 some experiments were made in England with the coöperation of Sir Oliver Lodge, the eminent English scientist, in the stimulation of plant growth by electricity. It has been frequently observed that plant growth is stimulated by electric light, and numerous experiments have been made having for their object the stimulation of the soil by the application of electric current. The experiments reported by Sir Oliver Lodge in a privately printed brochure on "Electricity in Agriculture" are briefly as follows:

Two tracts of land about 20 acres each were similarly sown or planted. On half of this land poles with insulators were erected to support the electric wires, only one pole per acre being required for the purpose. The electricity required was produced by a small dynamo driven by a 2-horsepower oil engine and was transformed to a tension of about 100,000 volts of very high frequency. The experiments, which extended over several years, gave remarkable results, an increase of from 30 to 40 per cent. being secured in wheat crops grown on the electrified plot as compared with the crop produced on the unelectrified plot. Moreover, the electrified wheat was of a better milling and baking quality. Similar experiments with strawberries, mangolds, tomatoes, cucumbers, beets and carrots showed equally remarkable results. One-year strawberry plants showed in one instance 80 per cent. increase and more runners produced, while with five-year plants the increase was 36 per cent.

In writing to me on this subject in response to my request, in order that I might make a reference to it in this address, Sir Oliver Lodge suggested that the results attained in the experiments referred to and in others would justify an elaborate series of experiments. These experiments could be usefully undertaken at the stations under the control of the Agricultural Department.

An explanation given for the excitation of vegetation by these high-tension currents is that high-frequency electrical discharges favorably affect the deposit of the nitrogen in the atmosphere into the soil, upon which deposit vegetation so largely subsists.

Whatever prevents disease and insures health contributes not only to man's happiness, but also to his efficiency, and it appears that the electric current is to play a very important part in this field.

It is said that during the last 160 years between 10 and 15 per cent. of the cities and towns in Massachusetts lost either the whole or a portion of their municipal records by fire. While this is probably fortunate in some cases for the descendants of the politicians, it does not tend to make accurate history possible. During the same time there are also many manufacturing concerns whose records have been similarly destroyed, which should serve to emphasize the necessity of guarding against fires both by extra precaution to prevent their starting and by protection of valuable records by steel office furniture and in other ways. We hardly realize the annual destruction by fire, which is all the more deplorable because a large percentage of it might easily be prevented by ordinary precautions and carefulness.

Giving Away a Telephone Patent

It is of interest to note that Major George O. Squier, United States Army, in giving to the general public his patent rights on a new system of multiplex telephony which he has invented, has been actuated by motives and a sense of duty seldom equaled at any time in history. He says in part: "Is it not right that I should give this to the public? I obtained my education through the American people; as an officer of the United States Army my time and all the good that may accrue from the use I make of that time and the education given me belongs morally to them."

The fact that he has put his invention, not only beyond the control of any monopoly, but beyond even his own, which might net him a fortune, speaks so eloquently of sincerity that this should set some heads to serious thinking. In all the maze that seems to envelop the patent situation, cases of this kind give hopes of a solution.

Increasing Shop Capacities

Metal Working

NEW ENGLAND

It is reported the Mason Machine Works, of Taunton, Mass., will move to New Bedford.

The Acme Wire Company, New Haven, Conn., is erecting an addition to its plant.

The Hart & Cooley Company, New Britain, Conn., manufacturing metal lockers, will erect a new factory building.

The Elliott Company, Boston, Mass., manufacturing addressing machines, will erect a three-story factory in Cambridge.

An extensive addition is to be added to the roll room of the Farrell Foundry and Machine Company, Ansonia, Conn.

The Connecticut Bed Spring Company, Waterbury, Conn., has been organized. A factory will be located in Waterbury.

Fire destroyed the plant of the Ansonia (Conn.) Novelty Company. Loss, $60,000. The concern manufactured metal novelties.

Lucier & Bissell, of Northampton, Mass., have leased quarters in Brattleboro, Vt., where they will open a large automobile shop.

The Veeder Manufacturing Company, Hartford, Conn., is erecting a three-story addition. The concern manufactures counters, tachometers, etc.

The Park City Motor Car Company, Bridgeport, Conn., has been incorporated to manufacture motor cars. Capital, $50,000. Incorporators, F. H. Macfarlane, P. S. Chapman, etc.

The Lockwood Manufacturing Company, Norwalk, Conn., manufacturer of locks and hardware, is to increase its capital stock from $200,000 to $1,000,000. Many improvements are contemplated.

The Tilford Manufacturing Company, Providence, R. I., jewelers, has been formed and will locate a plant in that city. G. H. Tilford, G. H. Huddy and S. A. Berry form the company, all of Providence, R. I.

Wm. E. Richards, formerly treasurer of Leach & Miller Company, manufacturing jewelers, Attleboro, Mass., will open a factory under the name of Richards Manufacturing Company, Robinson building, Providence, R. I.

F. W. Derbyshire, 155-57 High street, Waltham, Mass., is equipping a factory for the manufacture of watchmakers' lathes and attachments. Mr. Derbyshire was formerly superintendent of the American Watch Tool Company.

The Rex Horse Shoe Company, of Central Falls, R. I., has been incorporated with $50,000, and will do business in that city. The incorporators are R. Young, Bristol, R. I.; W. A. Countryman, Jr., and M. M. Spink, of Central Falls.

The Uncas Specialty Company, of Norwich, Conn., has purchased the Rochester Machine Tool Company, and the Sterling Lubricator Company, and will move plants to Norwich. Firm name will be changed to the Sterling Machine Company. The product of the Rochester concerns was automatic lubricators and parts for motors.

News items for the sales department — where more equipment will be needed. Authentic news is solicited for this department, not rumors or gossip — facts

MIDDLE STATES

E. Ganet is having a garage built at Wyncote, Penn.

The Camillus (N. Y.) Cutlery Company will enlarge its plant.

H. T. Saunders is having a garage built at 1420 Vine street, Philadelphia, Penn.

Nathan H. Davis is having a garage built at 5819 Drexel road, Philadelphia, Penn.

The Nolke-Richards Iron Works, Indianapolis, Ind., will erect an additional building.

A brass foundry is being contemplated by the Brandt-Dent Company, Watertown, Wis.

A new two-story factory is being erected by the Newago (Mich.) Engineering Company.

H. H. Noedel, 215 Twenty-eighth street, Milwaukee, Wis., will erect a $6000 garage.

The Western Electric Company will erect two manufacturing buildings, at Hawthorne, Ill.

B. F. Kerber is having a garage built at Sixty-first and Media streets, Philadelphia, Penn.

The Union Cutlery Company, of Tideoute, Penn., will erect a new factory at Olean, N. Y.

The Haynes Automobile Company, Kokomo, Ind., will rebuild at once, plant recently burned.

Foote Brothers Gear and Machine Company, Chicago, Ill., is erecting a three-story addition.

The Nelson Motor Truck Company, of Detroit, Mich., has been looking for site for a new plant.

Fire destroyed the garage of Priestley & Crossley, at 1572 Adams avenue, Philadelphia, Penn.

The Packers Motor Car Company, of Pittsburg, Penn., will establish a plant at Glenova, Penn.

H. P. Schneider is having a garage built at 2207-9 North Thirteenth street, Philadelphia, Penn.

The Cincinnati Milling Machine Company will erect a three-story addition to its Oakley plant.

The Axle Grease Company, at Galena, Ill., will enlarge its wire-handle factory and wire-machine industry.

Samuel Sternberger is having plans made for a garage at Broad and North streets, Philadelphia, Penn.

A large garage is to be erected on Madison avenue by the Imperial Motor Car Company, of Cincinnati, Ohio.

The Acorn Brass Manufacturing Company, of Chicago, Ill., has been looking for suitable site for a new plant.

A plant is to be erected by the Bainton Electric Steel Company, at Buchanan, Mich. Capital stock, $150,000.

A new tank factory will be erected by C. A. Freeland, Sturgis, Mich., on the site of the old building, which was recently burned.

McCaffrey & Farley, iron founders, Philadelphia, Penn., will erect a new foundry at 2314-16 Washington avenue.

The Modern Foundry Company is having plans drawn for an extension to its plant at Oakley, Cincinnati, Ohio.

Thomas McCaffrey is going to have a two-story brick foundry built at Twenty-third street and Washington avenue, Philadelphia, Penn.

The two-story brick garage, owned by J. Harrison, at Thirteenth street and Columbia avenue, Philadelphia, Penn., was destroyed by fire.

The Metropolis (Ill.) Foundry Company, recently incorporated, has taken over an existing plant, which will be enlarged in the near future.

The Canton Boiler and Engineering Company, of Canton, Ohio, has increased its capital stock and the size of the plant will soon be increased.

The Reliable Machine Company, toolmakers and machinists, Cleveland, Ohio, has recently completed its new building for which equipment will be needed.

O. Bryant & Sons Company, 15 Bradley street, Buffalo, N. Y., building special machinery, is erecting a new shop at West and Ternwood avenues.

The Public Service Corporation, of New Jersey is arranging to build a car house at Hilton, N. J. A portion of this will be used as a repair machine shop.

Kirk & Blum, sheet-metal workers, have nearly completed plans for their new factory and are soliciting quotations on the necessary metal-working machinery.

The Hayssen Manufacturing Company, H. and A. H. Hayssen and P. J. Stern, of Mil-

waukee, Wis., will erect a bread-wrapping machine factory at Sheboygan, Wis.

McLean Lock Wrench Company, Cleveland, Ohio, has been organized with $15,000 capital to manufacture wrenches by John C. McLean, C. H. Knight, C. Cole, etc.

The Welsh-Royal Company, Camden, N. J., has been incorporated with $25,000 capital by W. H. Welsh, J. Hird, H. Evert Kendig. Will manufacture typesetting machines.

The Frontier Brass Foundry Company will erect a new $15,000 foundry on Elmwood avenue, Niagara Falls, N. Y. The company now operates a foundry in Whitney lane.

The Evansville Marine Motor and Foundry Company, Evansville, Ind., has been incorporated with a capital of $20,000 by B. F. Drury, C. F. Donnelly and B. M. Mitchell.

J. M. Mellory & Son, tin-box manufacturers, are having a new five-story factory built at Broad and Brandywine streets, Philadelphia, Penn., 48x96 feet, to cost $24,000.

The Remington Ammunition Company, Weehawken, N. J., has been organized with $100,000 capital by P. E. Remington, P. N. Barnett, Edw. Hollander, to manufacture fire arms, etc.

The Harrisburg (Penn.) Manufacturing and Boiler Company will erect an $80,000 machine shop at Nineteenth and Nandain streets. High- and low-head turbines will be manufactured.

The Johnson Engineering and Construction Company, Battle Creek, Mich., recently organized, is to install steel and iron buildings and bridges and to manufacture steel and other metals.

Red King Company, Wauseon, Ohio, has been incorporated with a capital of $75,000 to manufacture wind mills, pumps, towers and tanks, by S. E. Schwarf, Joseph Sharp, William A. Wood, etc.

The Telling Brothers Ice Cream Company, Cleveland, Ohio, will erect a machine shop in connection with its new plant to be erected at Youngstown, for the manufacture of ice cream and ice.

The Southern Equipment Supply Company, Bedford, Ind., has been incorporated with a capital of $10,000 by H. E. Stillwell, C. B. Fletcher and F. Rieble, Jr., to manufacture equipment for quarries.

The New Castle (Penn.) Street Cleaning Company has been organized to manufacture street-cleaning machines. Capital, $20,000. Incorporators, R. H. Stephens, W. F. Davidson, R. C. English, etc.

The Gregg Company, Ltd., of Newburgh, N. Y., has erected five buildings, near Lodi, N. J., consisting of machine shop, assembling room, carpenter shop, power house, etc. Equipment will be needed.

The Eastern Motor Company, Atlantic City, N. J., has been incorporated to manufacture automobiles, motorcycles, etc. Capital, $50,000. Incorporators, E. G. Harris, W. V. Riley, P. G. Clark.

Kenyon Searchlight Company, Bedford, Ohio, has been organized to manufacture all kinds of electrical equipment and searchlights, by P. D. Metgzar, Robert H. McKay, P. C. Stoller, etc. Capital, $15,000.

The Teller Air-Burning Furnace Company, Jersey City, N. J., has been organized to manufacture furnaces, boilers, engines, etc. Capital, $300,000. Incorporators, F. A. Wineke, J. M. Mullen, Wirt A. Duvall.

Right O'Way Horn Company, Cleveland, Ohio, has been organized with $25,000 capital to manufacture automobile horns and other accessories. Incorporators, Ira E. Stump, Hugh Pease, William E. Eynon, etc.

A patent snow plow for use on steam and electric railroads will be manufactured by a recently incorporated concern to be known as the Rapid Turn Expeller Snow Plow Company, Detroit, Mich. Capital stock, $100,000.

The Newark Automobile Manufacturing Company, Newark, N. J., has been incorporated to manufacture and deal in automobiles. Capital, $500,000. Incorporators, A. E. Egner, W. E. Brown, Jr., Conover English.

The Ideal Electric Vehicle Company, Jersey City, N. J., has been incorporated to manufacture automobiles, mechanical and electrical appliances, etc. Capital, $250,000. Incorporators, H. A. Tuffel, R. G. Chace, C. A. Elliott.

The American Motor Truck Company, engaged for some time past in the manufacture of motor trucks, at Lockport, N. Y., has consolidated with the Findlay Motor Car Company, of Findlay, Ohio, and the entire plant will be moved from Lockport to Findlay in the near future.

The New York State Casting Company has been formed to operate a large portion of the Syracuse Stove Works, at 100 North Geddes street, Syracuse, N. Y. The plant will be enlarged; the new company will make aluminum and brass and a high-grade of gray-iron castings. Francis Kernan, president.

SOUTHERN STATES

The Central Foundry Company, Anniston, Ala., has let contract for an extension to the molding department.

The Sheet Metal Specialty Company has let contract for the erection of a $10,000 addition to its plant at Follansbee, W. Va.

The Jones Machine Company, Chattanooga, Tenn., is building an addition to be used as a foundry. The latest foundry equipment will be installed.

Harry W. Hunter, president of a new concern known as the Baltimore (Md.) Gas Appliance and Manufacturing Company, has purchased the property owned by the Consolidated Gas and Electric Light and Power Company. Gas ranges and heaters, etc., will be manufactured.

WEST OF THE MISSISSIPPI

The Santa Fe Railroad is planning to double the capacity of its shops at Richmond, Cal.

The Seattle Cornice Works, Seattle, Wash., is planning to erect a factory at Portland, Ore.

The Southern Pacific Railroad is planning to build a roundhouse and shops at Klamath Falls, Ore.

Geo. W. Merrill, Spokane, Wash., is planning for the erection of a large commercial garage and repair shop.

The Los Angeles Railway Company, Los Angeles, Cal., will build a large addition to its Eagle Rock car barns.

The Washington Steel and Iron Company, Spokane, Wash., is planning for the erection of a new smelting plant.

J. A. Mahoney, Deming, New Mexico, is having plans prepared for a machine shop. About $30,000 will be expended.

C. Powell, Portland, Ore., has commenced the construction of a commercial garage and repair shop. Modern equipment will be installed.

The Kenton Tin and Sheet Metal Works, Portland, Ore., has purchased property at Kenton (near Portland), and will erect a factory.

The Decker Manufacturing Company, Keokuk, Iowa, is erecting a new factory building for the manufacture of hardware specialties.

The Bakersfield Iron Works, Bakersfield, Cal., will build a large machine shop at Fellows, Cal. The plant will be fully equipped.

The Northwestern Railway will make extensive improvements at Boone, Iowa, including new roundhouse, additional repair shops, etc.

Judge Lovett, president of the Harriman lines, announced while at Tucson, Ariz., that the Southern Pacific shops at this place would be rebuilt.

The Phœnix Lighting Fixture Company, Los Angeles, Cal., recently incorporated for $100,000, will establish at once a large factory for the manufacture of lighting fixtures.

The Iowa Foundry Company, Sioux City, Iowa, will erect additional buildings to consist of new foundry, machine and pattern shops. The machine shop will be a new departure.

The Hamilton Motor Car Company will establish a commercial garage and machine shop at Santa Monica, Cal. Modern equipment will be installed. Headquarters of company, Pasadena, Cal.

The Bradrick Machine Works, recently incorporated, and operating at Porterville, Cal., has purchased property at Los Angeles, Cal., and will erect a machine shop. A foundry building is also planned.

The Thomas Elliptic Grate Bar Works, now operating a plant in Valdosta, Ga., will establish a branch plant at Houston, Tex. It is said the company will also operate a plant at Birmingham, Ala., and one in Canada.

CANADA

Atkins & Watson will locate a large auto repair plant at Vancouver.

The Canadian Iron and Metal Company will locate a factory at Montreal.

The Herod Machine and Motor Company will locate a plant at Brantford, Ont.

The Oliver Chilled Plow Company announces that it will build another $200,000 addition to its plant at Hamilton.

General Manufacturing

NEW ENGLAND

The borough of Groton, Conn., will require pumping machinery.

Bridgeport, Conn., contemplates installing a new sewer system.

The Greenfield (Mass.) Laundry Company will build an addition to its plant.

The United Candy Company, Roxbury, Mass., will install boiler and engine.

The Three Case Shoe Company, Stoughton, Mass., is in the market for fire pumps.

The Coöperative Coal Company, Pittsfield, Mass., will install conveying machinery.

The Consolidated Electric Light Company will install waterwheels at Standish, Me.

The sawmill at Morrill, Me., owned by Hermann Merriman, was destroyed by fire.

The city of Quincy, Mass., will make extensive improvements in its sewer system.

The W. H. McElwain Company will install an electric generator at Manchester, N. H.

The Pond Foundry and Machine Company, Worcester, Mass., is in the market for pumps.

The Boston Manufacturing Company, Waltham, Mass., is building a new boiler house.

Somerworth, N. H., has petitioned for the right to build a municipal electric-light plant.

The box factory of C. H. Hayes Company, Haverhill, Mass., destroyed by fire. Loss, $50,000.

The Bradford Durfee Textile School, Fall River, Mass., will add 125 horsepower to its steam plant.

A $50,000 artificial ice plant is to be built for Devereaux Lake Company, East Portchester, Conn.

Glenlyon Dye Works, Saylesville, R. I., is erecting an addition to be used as a yarn splitting building.

The Salts Textile Manufacturing Company, East Bridgeport, Conn., is to erect an addition to its plant.

The Superior Laundry Company, of Springfield, Mass., will build a new laundry on Pearl and Worthington streets.

The Great Falls Manufacturing Company, Somersworth, N. H., is making additions to its carding and weaving rooms.

The Lincoln & Williams Twist Drill Company, Taunton, Mass., has purchased another building and will install an oil engine.

The Providence Braid Company, Pawtucket, R. I., is to erect a three-story mill and an addition to the present factory.

The Westminster Granite Company, of Providence, R. I., will erect three new buildings to be used as boiler house, work shop, etc.

The Columbia Carriage and Rattan Company, Fitchburg, Mass., is equipping a factory for the manufacture of children's carriages.

The Plymouth Rubber Company, of Stoughton, Mass., is erecting a new plant at Canton, Mass. Is in the market for a low-pressure steam turbine.

A large addition is to be built to the Eclipse mill, in North Adams, Mass. A new power plant is to be constructed that will care for the entire plant.

The Seward Rubber Company plant, at New Britain, Conn., has been purchased by G. W. Wooley & Son, of Hartford, who will manufacture caskets and fittings there.

The Hibbard Index Company, a $50,000 corporation, will locate a plant in Worcester, Mass., for manufacturing telephone indexes from patents secured by Herbert O. Hibbard.

Motors are to be installed in the factory building of A. H. Bliss Company, Attleboro, Mass., in order that all the firms in the building may operate their machinery by electric power.

The New Tavern Dairy Company, manufacturer of ice cream and similar products, is adding a two-story addition to its Hartford, Conn., factory, and will also shortly build a refrigerating plant.

The Allyndale White Marble and Lime Company, of Hartford, Conn., has been incorporated for $200,000 and will quarry marble and limestone. Incorporators are H. W. Philbrick, F. C. Barholff and E. S. Goodrich, all of Hartford, Conn.

MIDDLE STATES

A waterworks system will be installed at Mitchell, Ind.

The Junction City (Ohio) Fertilizer Company will build a new plant.

The Hollencamp Brewing Company, Dayton, Ohio, will erect an addition.

Mount Morris, N. Y., has voted to spend $100,000 on a new water system.

Leslie, Elliott Company, Paterson, N. J., will erect an addition to its boiler shop.

The Wagener Shoe Company, Penn Yann, N. Y., would erect an addition to its plant.

Power equipment will be needed for a new high school to be erected at Van Wert, Ohio.

The city of Madison, N. J., will make additions to its municipal electric-light plant.

The Iola Starch and Potato Company, at Roshalt, Wis., will erect a pickling station.

Berner Brothers' sawmill, at Rozellville, Wis., was destroyed by fire. Will be rebuilt.

Fire did $10,000 damage to the knitting mill of Yund, Kennedy & Yund, Amsterdam, N. Y.

The Nelsonville (Ohio) Electric Light Company will make improvements to its plant.

Improvements will be made to the municipal waterworks system at East Liverpool, Ohio.

Batty & Northrup's glove-manufacturing plant, Gloversville, N. Y., was burned. Loss, $65,000.

Fire destroyed the coal elevator of Daniel S. MacMullen, at Hackensack, N. J. Loss, $75,000.

The plant of the C. A. Durr Packing Company, Schuyler street, Utica, N. Y., will be enlarged.

The Scranton (Penn.) Electric Company is to spend $1,000,000 on improvements to its system.

The Acme Tea Company, Philadelphia, Penn., is looking for a site on which to erect a large bakery.

The Olympian Knit Goods Company, of New Hartford, N. Y., will build a $60,000 addition to its plant.

The Miller Brewing Company, of Milwaukee, Wis., will build a cold-storage plant in New Orleans, La.

A new packing-box factory is being erected for W. H. Downing, at Front and Chew streets, Allentown, Penn.

R. R. Lloyd, stair manufacturer, is having an addition built at Twenty-second and Race streets, Philadelphia, Penn.

The sewer-pipe plant of the National Fire Proofing Company, at East Palestine, Ohio, was burned. Loss, $75,000.

The Peerless V Belt Company, of Chicago, Ill., will move to Cedar Rapids, Iowa, where a new plant will be erected.

The Avondale Ice Company will erect a two-story plant on Emery avenue, near Shillito street, Cincinnati, Ohio.

M. A. Gwiklinski, of 35 Lathrop street, East Buffalo, N. Y., will erect a planing mill on Hawlett street, East Buffalo.

The hair-cloth factory of Gordon Brothers & Co., Frankford, Philadelphia, Penn., was destroyed by fire. Loss, $150,000.

C. J. Webb & Co. have leased the building at 414 to 416 South Front street, Philadelphia, Penn., for manufacturing waste.

Gould Brothers are remodeling the property at 153 Tenth street, Philadelphia, Penn., for the manufacture of picture frames.

The Telling Brothers Ice Cream Company will erect a large ice cream and ice-manufacturing plant, at Youngstown, Ohio.

The Portage Rubber Company, of Barberton, Ohio, has broken ground for a new factory alongside its present reclaiming plant.

The Lifter Ice Cream Company is going to build an addition to its plant at American and Buttonwood streets, Philadelphia, Penn.

The Eagle Hat Manufacturing Company will build a factory at 2441 to 2447 East York street, Philadelphia, Penn., to cost $100,000.

The Mitchell-Hostetler Lumber Company, Mitchell, Ind., has been incorporated by A. H. Hostetler, J. F. and F. C. Mitchell to operate sawmills.

The Decatur Supply Company, Decatur, Ind., has been incorporated by Daniel Sprang, C. J. Lutz and D. R. Vail to manufacture egg cases.

The Keystone Brick Company, of Tabor road and West Vankirk street, Philadelphia, Penn., is going to have a boiler and engine house built.

The Havana-American Company, a branch of the American Tobacco Company, will erect a $175,000 cigar plant on Twelfth street, Chicago, Ill.

Plans are being prepared for a power house to be erected in connection with the new Technical high school by the city of Buffalo, N. Y.

The American Viscose Company, manufacturer of artificial silk, at Marcus Hook, Penn., is building a three-story and a one-story addition.

The Philadelphia Storage Battery Company is having a two-story addition built at the corner of Ontario and C streets, Philadelphia, Penn.

The Brunner Baking Company, located at 263 Oak street, Buffalo, N. Y., has completed plans for a two-story building at Oak and Sycamore streets.

The North Brewster (Ohio) Electric Light, Heat and Power Company, recently organized, is planning to build new light, power and water plants.

The Canton Rubber Company, of Canton, Ohio, has increased its capital stock from $35,000 to $200,000 and will install a large amount of machinery.

The Illinois Valley Gas and Electric Company, Streator, Ill., is considering the erection of a power house on some property, which it has recently purchased.

The McCrillis Handle Company, of Norwalk, Ohio, will soon install a 150-horsepower boiler in its plant. A new boiler room 30x20 feet, will be built.

Fire in Binghamton, N. Y., damaged the plant of the Vail-Ballon Publishing Company, to the extent of $80,000, and plant of the *Democrat News*, $10,000.

The Beechnut Packing Company has erected a new building at Canajoharie, N. Y., and proposes to extend operations and take up the manufacture of gum.

The German-American Sugar Company, with its plant at Paulding, Ohio, is contemplating the establishment of a million-dollar sugar refinery at Findlay, Ohio.

American Laundering Company, Columbus, Ohio, has been incorporated to operate a laundry by Oliver E. Davis, William J. Ford, A. Brandon, etc. Capital, $50,000.

Harry Bissering & Co., of Chicago, contemplate the erection of a plant at Hammond, Ind., for the manufacture of silos, and have acquired land for the purpose.

The Riverside Malting Company, operated by C. G. Curtiss Company, at Black Rock, N. Y., has doubled its capital stock, and will make extensive improvements to its plant.

Urichsville Clay Company, Urichsville, Ohio, has been organized with a capital of $50,000, to manufacture clay products of all kinds, by W. A. Calden, Bernard Minnich, A. A. Parr, etc.

Sylvester Duquaine, of Green Bay, Wis., and H. S. Duquaine, of Crivitz, Wis., also H. I. Norton, of Marinette, Wis., will build a plant to manufacture paper fiber at Amberg, Wis.

The Schulte Shoe Company, Springfield, Ohio, has been organized with $10,000 capital to manufacture shoes by Charles H. Schulte, Fred C. Schulte, Anna M. Schulte, Orville Evan Ream, etc.

Fire recently, in the plant of the United States Carriage Company, South Fourth street, Columbus, Ohio, caused a loss of about $25,000. Destruction of machinery was one of the largest losses.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., April 3, for furnishing paints, white lead, gasolene, sal soda, graphite, metal polish, etc., for the year ending June 30, 1912.

The Henry Prasse Company, South Euclid, Ohio, has been formed with $75,000 capital to manufacture boxes, caskets and other products of lumber. Incorporators, Henry Prasse, Henry Faust, George J. Echert, etc.

Walker Brick and Tile Company, Dillonvale, Ohio, has been incorporated with $50,000 capital to manufacture brick and tile and all clay products. Incorporators, H. Walker, W. S. Parlett, W. M. Cattell, William R. Clark, E. F. Walker and G. W. Tidrick.

The city of Peru, Ind., has erected new buildings for its waterworks and electric-light plants, and the common council has decided to spend at least $60,000 to put the plants in the best possible working condition. Godlove Conradt, of Peru, will have full charge of the improvements.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., April 5, for supplies for the year ending June 30, 1912, as follows: Lubricating oils and greases, including locomotive, engine valve, car, stationary and marine engine oils, crank pin, cable, yellow and black greases.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids March 21, for 2000 pounds steel bolts and rivets (schedule 3385), 700 bronze padlocks, 240 screw wrenches (schedule 3384), 17,500 pounds cold drawn steel, 12,500 pounds bar steel, 15,000 hot rolled or forged steel (schedule 3381).

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids April 4, for hinges, padlocks, planes, machine screws, brass wood screws (schedule 3388), steel nuts (schedule 3392), antimony, sheet brass, sheet copper (schedule 3392), galvanized steel, black sheet steel (schedule 3389).

SOUTHERN STATES

The Winston-Salem (N. C.) Power Company will install a 500-kilowatt generator.

The Proctor & Gamble Company is to erect a large cotton-seed oil mill in Memphis, Tenn.

The Purity Ice Cream Company will erect a three-story factory at 10 South Jefferson street, Richmond, Va.

The Nortonville (Ky.) Coal and Coke Company will erect a power house and is also planning to improve its present facilities.

Contract has been awarded for the erection of a large paint factory for John T. Lewis & Brother, at 1015-19 East Fayette street, Baltimore, Md.

The Foltz Manufacturing Company, Humboldt, Tenn., ice manufacturer, plans to double the capacity of its plant, which will necessitate new equipment.

WEST OF THE MISSISSIPPI

Cole Hastings, of White, S. D., will build a feed mill.

Seneca, Kan., is to expend $15,000 to improve its waterworks.

The Berlin Dye Works, Seattle, Wash., will build an addition to its plant.

Butler Brothers, Dallas, Tex., have taken out a permit to erect a box factory.

The Oregon Door Company, Portland, Ore., will build an addition to its plant.

The citizens of Billings, Mo., are agitating the question of a waterworks system.

The Model Creamery Company, at St. Boniface, Minn., will erect a building.

Daniel Eldred, Tacoma, Wash., has taken out a permit to erect a carpenter shop.

The Sterling Stone Company, Portland, Ore., will build an addition to its plant.

The Pacific Creamery Company, Tempe, Ariz., will build an ice and cold-storage plant.

The American Beet Sugar Company, Oxnard, Cal., will build an addition to its plant.

Fred Huffman, Sites, Ida., is at the head of a project to erect a large creamery plant.

The Farmers Coöperative Creamery Company will erect a creamery at Granger, Minn.

C. L. Mott, of Des Moines, Iowa, is considering the erection of a flour mill at Mott, N. D.

The Husum Power Company, Husum, Wash., will increase the capacity of its power plant.

The Falls City Mill and Feed Company, Spokane, Wash., will build an addition to its plant.

The Anatone Mill Company, Anatone, Wash., will make improvements in its lumber plant.

The city of The Dalles, Ore., is contemplating the erection of an electric-lighting plant.

The Exchequer Mining and Power Company, Merced, Cal., will build a new power plant.

The city of Leavenworth, Wash., will install a new sewer system. Bids are being asked.

The city of Rockford, Wash., is planning for extensive improvements in its water system.

The Roswell (N. M.) Gas and Electric Company will start work on a new plant shortly.

The Northern Cold Storage and Warehouse Company, of Duluth, Minn., will double its capacity.

J. M. Thompson, president of a creamery company, at Baldwin, N. D., will erect a creamery.

A 50,000-bushel grain elevator is to be erected by the Jonesboro (Ark.) Roller Mill Company.

The city of Roseburg, Wash., is planning the installation of a sewer system in West Roseburg.

The Placentia Orange Growers' Association, Placentia, Cal., will install a precooling plant.

The California Fruit Canners' Association, Hanford, Cal., will increase the capacity of its cannery.

The city of Jacksonville, Ore., will install a waterworks system. About $30,000 will be expended.

The El Paso Electric Railway Company, El Paso, Texas, will build an addition to its power plant.

The Ellensburg Water Company, Ellensburg, Wash., is planning to make extensions in its system.

The Black Hills Broom Company, E. E. Linch, manager, will erect a factory at Belle Fourche, S. D.

A new factory is to be erected by the Acheson Oildag Company, at Huron, Mich., late this spring.

The International Lumber Company, of International Falls, Minn., will erect a new sawmill at once.

The plant of the Oregon-Washington Lumber Company, at South Portland, Ore., was destroyed by fire.

The Siskiyou Electric Light and Power Company, Yreka, Cal., is planning for extensions in its system.

The Gordon Syrup Company, Oakland, Cal., will remove its plant to Berkeley. New machinery will be installed.

The Star Brewery Company, Vancouver, B. C., is planning for the erection of a new plant and bottling works.

The Golden State Dairy, Fresno, Cal., will build a new creamery plant. Refrigerating apparatus will be installed.

The Spokane Company, Spokane, Wash., is planning for extensive alterations in its boiler room and equipment.

The Michigan United Railways Company, Jackson, Mich., is to install power plants to be operated by the company.

The Independent Malting and Brewing Company, Oakland, Cal., has taken out a permit to erect a new plant.

The Milwaukee Electric Company, Libby, Mont. (J. H. Ehlers), is planning to build a power plant on the Yank river.

The Panhandle Lumber Company, Cœur d'Alene, Idaho, will improve and enlarge its plant to the extent of $1,000,000.

The Irving-Pitt Manufacturing Company, Kansas City, Mo., making loose-leaf devices, will erect a three-story addition.

The Balfour-Guthrie Company, Portland, Ore., is planning for the erection of a power plant on Mill creek, Turner, Ore.

The city of Orland, Cal., is planning to install a waterworks and sewer system to cost $23,000 and $27,000, respectively.

The Diamond Carriage Company, Spokane, Wash., will build an addition to its factory. Modern equipment will be installed.

The McLaughlin Tie and Timber Company will erect a sawmill at Ranchester, Wyo., with a capacity of 75,000 feet daily.

The Union Sugar Company, Santa Maria, Cal., is planning for extensive irrigation work on its property in this section.

The showcase factory of the Heimaan-Miller Manufacturing Company, St. Louis, Mo., was burned. Loss, about $45,000.

The Pitchless Lumber Company, St. Johns, Ore., is planning to manufacture furniture, and will build a plant for this purpose.

The Brooks Oil Company, operating in the Midway field, Kern county, Cal., is contemplating the erection of an asphalt plant.

The capital stock of the Fort Madison Chair Company has been increased and it will increase its capacity. Will need new machinery.

The Sacramento Valley Irrigation Company, Hamilton City, Cal., is planning for extensive irrigation work on 15,000 acres.

The Hogue-Kellog Company, Ventura, Cal., will build a fruit-packing addition to its plant. Modern equipment will be installed.

The Puente Land and Water Company, Puente, Cal., is planning for extensive irrigation work. About $20,000 will be expended.

C. A. Buswell, Porterville, Cal., will install a large irrigation works in this section. Engines, pumping-plant equipment, etc., will be required.

The A. W. Phelps Company, Fullerton, Cal., has commenced the erection of a fruit-packing plant. Modern machinery will be installed.

The Schwarzchild & Sulzberger Company, Chicago, Ill., packers, is reported to be contemplating the erection of a plant at Portland, Ore.

The plants of the Gold Medal shingle mill and the Multnomah Lumber Company, at South Portland, Ore., were destroyed by a large fire.

W. R. Echols and Ed. Rankin, formerly of Faxon, Okla., will erect a plant for the manufacture of ice and a creamery at De Witt, Ark.

The Escondido Mutual Water Company, Escondido, Cal., is planning to install a rock-crushing plant. Modern equipment will be installed.

The Western Colonization Company, Portland, Ore., is contemplating the installation of a pumping plant on its property, near Ontario, Ore.

The Southern California Gas Company, Los Angeles, Cal., is planning to build a pressure plant, for gas-works system, at Pomona, Cal.

The plant of the Mt. Vernon Lumber and Manufacturing Company, Mt. Vernon, Wash., was destroyed by fire. Will be rebuilt on an increased scale.

The Elkhorn Valley Condensing Company, of Waterloo, Iowa, is planing the construction of a plant with a 450,000-pound milk daily capacity.

The Charles Heights Orchards Company, Missoula, Mont., is planning extensive irrigation work in this vicinity. About $80,000 will be expended.

The plant of the Maier Brewing Company, Los Angeles, Cal., at Williams, Ariz., was destroyed by fire. The plant will be immediately rebuilt.

The Holley Electric Company, Porterville, Cal., has purchased property at Strathmore, and will soon commence the erection of a power substation.

The city of Bakersfield, Cal., is planning to install a sewer system in one of its outlying districts to cost about $25,000. Bids will soon be asked.

The Hayward Lumber and Investment Company, Los Angeles, Cal., has purchased property at San Dimas, Cal., and will establish a lumber plant.

F. E. Weymouth, United States supervising engineer, at Boise, Ida., has announced that a 15,000-horsepower power plant will be built in this section.

Power-plant equipment will be required for the new theater to be erected at Boise, Ida. About $350,000 will be expended. J. W. Smith, architect, Boise.

The Pasco Brick, Tile and Construction Company, Pasco, Wash., is planning to build a plant for the manufacture of these and kindred building materials.

The New York Motion Picture Company, New York, has purchased property at Edendale (near Los Angeles, Cal., and will build a $20,000 moving-picture plant.

The Golden Gate Fruit Company, Alameda, Cal., has purchased property at Van Nuys (near Los Angeles), Cal., and will erect a large factory for fruit products.

Power-plant equipment will be required in the new hospital to be erected by the St. Elizabeth's hospital, at North Yakima, Wash. About $200,000 will be expended.

S. F. Bowser & Co., of Fort Wayne, Ind., will establish a branch factory at Dallas, Tex., for the manufacture of its self-measuring oil tanks and oil-storage system.

Power-plant equipment will be required for the new 14-story office building to be erected at Montgomery and Bush streets, San Francisco, Cal. About $300,000 will be expended. Curtis Tobey, architect, San Francisco.

Power-plant equipment will be required in the new Metropolitan theater to be erected at Seattle, Wash. The Stone & Webster Company, Seattle, has the general contract.

The Deming Ice and Electric Company, Deming, New Mexico, is having plans prepared for a cold-storage and ice-manufacturing plant. About $15,000 will be expended.

The city council, Durant, Okla., has voted to accept plans and specifications for the construction of an electric-light plant and has instructed the city clerk to advertise for bids.

The Cotton Land and Water Company, Tucson, Ariz., is planning for extensive irrigation work on 50,000 acres in Mojave valley. Numerous pumping plants will be installed.

The Merchants Light and Power Company, Ogden, Utah, has been incorporated. Capital stock, $500,000. The company will begin work immediately upon the construction of a power plant.

The West Ontario Citrus Association has been incorporated at Ontario, Cal., with a capital stock of $35,000. The company will engage in the fruit-packing business. G. G. Laidlaw, Ont., is head of company.

P. B. Herman and E. L. Churchill, Grants Pass, Ore., have been granted a franchise for a gas plant. The plant must be thoroughly modern and be completed within eight months. Plans are now being prepared.

The N. A. Kennedy Butter Tub Company, Kansas City, Mo., has been incorporated for the manufacture of butter tubs, etc. Capital stock, $20,000. Incorporators are N. A. Kennedy, H. C. Offutt, J. J. Forrest and others.

The Lovegren Lumber Company, Portland, Ore., operating lumber mills at Gaston, is planning for the erection of a plant on this property for the manufacture of building tile. Full equipment of machinery will be installed.

The Gerber Water and Light Company has been incorporated at Gerber, Cal., by E. H. Gerber and G. W. Peltier, of Sacramento, Cal., with a capital stock of $50,000. The company is planning extensive operations in this section.

The board of supervisors, Los Angeles county, Cal., is contemplating the installation of an electric-lighting plant in the new Hall of Records, Los Angeles, Cal. Estimated cost, $20,000. Hudson & Munsell, architects, Los Angeles.

The city of San Diego, Cal., is in the market for a 60-horsepower engine and pumping equipment for the Point Loma reservoir. Plans and specifications are being prepared and bids will soon be asked. H. R. Fay, superintendent of water system.

Power-plant equipment will be required in the new Washington hotel to be erected at Seattle, Wash. About $225,000 will be expended. The contract for building construction has been let to the Black Masonry and Contracting Company, St. Louis.

The Tempe Woolen Mills Company has been organized at Tempe, Ariz., by W. W. Woodring and F. L. Richmond, Chicago, Ill., and Ernest Stoud, of Phœnix. The company has selected a site and will erect a factory. About $150,000 will be expended upon machinery and equipment.

The California Development Company, Los Angeles, Cal. (Henry Busse, president), will establish a large industrial plant in this city. A factory for the manufacture of pottery will immediately be built. This will be followed by an iron and bronze foundry, metal and woodworking shops.

CANADA

Harriston, Ont., will install a new waterworks system.

Lethbridge, Alberta, will spend $800,000 for new waterworks.

The Empire Paper Products will locate a plant at Sombra, Ont.

Yorkton, Sask., will install a complete electric-lighting system.

Cushing Brothers, of Calgory, will build a large woodworking factory.

Goderich, Ont., will spend $30,000 extending its waterworks system.

The Hoover Suction Sweeper Company will locate a plant at Windsor.

The Ideal Packless Valve Company will locate at Walkerville, Ont.

The Gidduys Chair Company will build a new factory at Granby, Que.

The Swift Canadian Company will locate a big plant at Fort William, Ont.

The George Rathbone Company, of Toronto, will locate large sawmills in Ontario.

Chappell Brothers, of Sydney, N. S., will erect large sawmills at Dalhousie, N. B.

The C. P. R. will spend $50,000 equipping a pumping plant at North Portal, Sask.

Moose Jaw, Sask., will buy two electrically driven centrifugal pumps and auto starters.

The National Brick Company, of Montreal, will locate a $2,000,000 plant at LaPrairie, Quebec.

The Kaministiquia Power Company, of Fort William, will spend $250,000 improving the plant.

The Seymour Electric Light and Power Company, of Port Hope, is building a new substation.

The Shawinigan Pulp and Paper Company will locate a new factory at Shawinigan Falls, Que.

The Alberni Electric Light and Power Company will equip a large plant at Alberni, B. C.

The plant of the Ives Modern Bedstead Company, wiped out by fire, at Montreal, will be rebuilt at once. Loss, $150,000.

Thomas Gibson, of Toronto, is head of the Lake Superior Paper Company, which will locate a big plant near Sault Ste. Marie.

MINING

The Black Bear mines, Cœur d'Alene district, Idaho, will install a 300-ton mill.

The West Kendall Mining Company, Kendall, Mont., will install a new milling plant.

The Atlas Wonder Mining Company, Wonder, Nev., will install a 20-stamp mill.

The Ontario mine, Summit county, Utah, will remodel its mill and install new equipment.

The El Dora Oil Company, operating in the Midway field, Cal., is purchasing new equipment.

The Yellow Tiger mine, near Goldfield, Nev., is contemplating the installation of machine drills.

The True Fissure Mining Company, Jarbidge, Nev., will soon be in the market for a milling plant.

The Ray Central Copper Company, Ray, Ariz., will install new drilling equipment in the near future.

Thomas Pope, Salmon, Idaho, operating the Bertsal gold mines, is planning to install a milling plant.

The Consolidated Mining and Smelting Company, Boundary Falls, B. C., will build a cyanide plant.

The Rough and Ready mines, Tuolumne district, Cal., will install new machinery in the near future.

The Eureka Mining Company, operating near Wallace, Idaho, is contemplating the erection of a mill.

The Jewett Oil Company, operating in the McKittrick field, Cal., is planning to install new boiler equipment.

The Kern Trading and Oil Company, Coalinga, Cal., will install an air-compressor plant on its Davis lease.

D. A. Lennox and W. C. Crauford, operating on the Frisco river, near Summit, Ariz., will install new machinery.

The Transvaal Copper Company, operating at Cumpas, Sonora, Mexico, is planning to install a concentrating plant.

The Esmeralda mine, Parral district, Mex., is reported to be contemplating the installation of an ore-treatment plant.

The California-Nevada Copper Company, operating the Basin mine, near Juneau, Alaska, will install a stamp mill.

The Pedrazzini Mining Company, operating the Chespas mine, near Arizpe, Sonora, Mex., will install a cyanide plant.

The DeGroff Mining Company, operating the Mills mine, near Sitka, Alaska, will increase the capacity of its stamp mill.

The Hermosa (N. M.) Consolidated Mining and Reduction Company has completed plans for a 200-ton concentrating and cyanide mill.

The Deadwood Consolidated Mining Company, operating at Poker Flat, Sierra county, Cal., will install new machinery. A. B. Call, manager.

The Oriflamme mine, Alleghany district, Sierra county, Cal., will install new electrical equipment in the near future. A mill will be erected.

The Domingo mines, Salmon copper district, Idaho, will install an air-compressor plant in the near future. Development work is planned.

The Seattle Cascade Mining Company, Seattle, Wash., operating in the Cascade Range district, will install a 100-ton concentrating plant.

The Indian Copper Company, Augusta, Me., is planning to operate extensively at Hanover, N. M. New drilling equipment will be immediately installed.

The Elk City Mining, Milling and Reduction Company has been organized at Elk City, Idaho. The company is planning to erect a five-stamp mill.

The Elk City Mines Corporation, operating the South Fork mine, Cœur d'Alene district, Idaho, will install a new milling plant on the South Fork river.

The Alaska-Treadwell Gold Mining Company, Juneau, Alaska, is planning for extensive operations. About $600,000 will be expended; a large stamp mill will be erected.

The United States Smelting, Refining and Mining Company, of Boston, Mass., is reported to be contemplating the erection of a smelting plant in the vicinity of Los Angeles, Cal.

The Nevada-Douglas Copper Company, operating in the Yerington district, Lyon county, Nev., is installing new hoisting equipment. An aërial tramway is to be built.

The Arizona Smelting and Mining Company (J. H. Thompson, manager), Tucson, Ariz., will build a 500-ton smelting plant in this vicinity. About $25,000 will be expended.

The Pioneer Dry Placer Company, headed by W. R. Lawton, San Francisco, Cal., operating in the Summit district, near Randsburg, Cal., is planning for extensive work on new placer property; a concentrating plant will be erected.

The Calumet & Copper Creek Mining Company, Los Angeles, Cal., operating in the Copper creek district, Ariz., has issued bonds for $1,000,000. The company is planning extensive work, the capacity of the mill will be increased 1000 tons, and new mining equipment will be purchased.

Business Items

J. G. Bellinger has purchased his partners' interest and is now sole owner of the Cleveland Machine Tool Works, Cleveland, Ohio.

The Hanna Engineering Works, Chicago, Ill., have entered into a contract with the Electric Machinery Sales Company, of Milwaukee, Wis., to succeed them as general sales agents for the Ajax electric riveting machines.

Forthcoming Meetings

American Supply and Machinery Manufacturers' Association, National Supply and Machinery Dealers' Association and Southern Supply and Machinery Dealers' Association; joint annual convention, Hotel Seelbach, Louisville, Ky., April 3-5, 1911. F. D. Mitchell, secretary, 309 Broadway, New York City.

National Metal Trades Association, thirteenth annual convention, April 12-13, Hotel Astor, New York City. Robert Wuest, commissioner, New England building, Cleveland, Ohio.

American Foundrymen's Association, annual convention, Pittsburg, Penn., May 23 to 26, 1911. Richard Moldenke, secretary, Watchung, N. J.

American Society of Mechanical Engineers, spring meeting, Pittsburg, Penn., May 30 to June 2, 1911. Secretary, C. W. Rice, 29 West 39th St., New York City.

The Institute of Operating Engineers. Regular meeting second Thursday of each month, Engineering Societies building, New York City. M. W. Rice, secretary, 29 West Thirty-ninth street, New York City.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. S. Clark, secretary, 141 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Philip Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

Philadelphia Foundrymen's Association; meetings first Wednesday of each month, Manufacturers Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

WANTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care, 505 Pearl Street, New York, will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G.Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Work for screw machines and gear cutter. Box 775, AMERICAN MACHINIST.

Mechanical drawing, light, accurate machine work. J. B. Poore, Washington, N. J.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

The Brunswick Refrigerating Co., of New Brunswick, N. J., are prepared to take on one or more manufacturing propositions.

Punches and dies, light and medium weight machinery, jigs and fixtures, etc., built to order. Taylor-Shantz Co., Rochester, N. Y.

Patents. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 990 G St., Washington, D. C. Write for Inventor's Handbook.

Agency for machinery and tools, covering Pittsburg district, is wanted by well known and established engineer. "Engineer," Box 491, AMERICAN MACHINIST.

Wanted—An article to manufacture suitable for the railway, automobile or hardware trade; must be patented and exclusive. Address Box 356, AMERICAN MACHINIST.

Light and medium weight machinery and small parts in quantities; also screw machine and punch press work, tools, jigs, dies and high grade machinery. The Elgin Tool Works, Elgin, Ill.

Tools, dies, jigs and light and medium weight machinery designed and built to order; duplicate parts, either machined or die cast. Precision Die Casting Co., 422 So. West St., Syracuse, N. Y.

Wanted—More capital in manufacturing a small machine, on the market less than one year; no competition; constantly increasing orders demand it; write today. Box 601, AMERICAN MACHINIST.

Large English firm of machine tool importers having showrooms and offices in Great Britain, France, Germany, Italy, India and Japan is wanting good agencies for machine tools of all kinds. Box 189, AMER. MACH.

Wanted—Small engine lathe, 20-inch drill press, reamers, cutters, bench tools, etc., in exchange for brand new electric breast drills, electric center grinders, motor grinders, power motors, dynamos, etc. Box 606, AM. MACH.

Monoplane of improved type and original features; designed by master mechanic, long experience on inventions and development work; arrangements with some one desired to manufacture and market machine. Box 590, AMERICAN MACHINIST.

Wanted—One second-hand universal grinder, medium size; one second-hand shaper about 16 inches; one second-hand universal miller, complete for cutting spirals, small to medium size. Highland Park College, O. H. Longwell, president, Des Moines, Iowa.

Representative, eighteen years' experience, good office, stenographer, salesmen, room to show goods, desires to sell products of responsible uptodate concern on commission; centrally located, New York City; best of references. Box 541, AMERICAN MACHINIST.

Manufacturer of telegraph machines, adding machines, taxameters, accurate interchangeable parts, dies and special tools, invites orders for similar special manufacturing. The Universal Telegraphic Company, Successors to the Rowland Telegraphic Company, Baltimore, Md.

Wanted—Partner with moderate capital in a growing business, no incumbrance, in a manufacturing center in Canada; must possess a thorough knowledge of jig designing and how to produce small, interchangeable parts requiring accurate assembling for mechanics' tools; also gear cutting and building of marine motors. Box 611, AM. MACH.

HELP WANTED

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—General business manager by well known firm manufacturing small tools, employing about 65 people; would have to take full charge of office, sales, purchasing and advertising; must be experienced; a good position for the right man and a good chance to advance. Apply to Box 598, AM. MACH.

ILLINOIS

Draftsmen—For tool drafting work; we need men who have had experience as designers on punch and die or jig and fixture work; in answer, state fully your experience along this line of work, salary desired and how soon you could report. Address Department 1056, Western Electric Co., Chicago.

MICHIGAN

Wanted—Experienced machine shop foreman, boiler shop foreman and layer out, also locomotive draftsman and car shop foreman; all must be strictly up to date in productive results and shop organization. Address Manager, P. O. Box 543, Detroit, Mich.

NEW JERSEY

Wanted—Throughly competent draftsman on condensers, pumps, etc; location near New York; state age, experience and salary expected. Address Box 570, AMER. MACHINIST.

By manufacturer of specialty, located within 14 miles of New York, in State New Jersey, diemakers, men with experience in manufacture of porcelain and rubber molds preferred; good wages and steady employment. Box 599, AMERICAN MACHINIST.

By manufacturer of specialty, located within 14 miles of New York, in State of New Jersey; foreman to take charge of shop making own dies; man with experience in manufacture of porcelain molds preferred. Box 600, AMERICAN MACHINIST.

NEW YORK

Wanted—Draftsman on power pump work; state age, character, education, experience and salary wanted. "Power Pump," AM. MA.

Wanted—A first class designer for special printing machinery; only those who can furnish the best of references need apply. Box 566, AMERICAN MACHINIST.

Wanted—Brass foundry foreman, experienced on valve castings preferred; state age, married or single and if at present employed; good opportunity for right man; location in New York State. Box 587, AMER. MACH.

Wanted—Live young man, experienced in cost keeping and shop practice, for large plant located in city of 20,000 inhabitants; good position for right man; state age, experience and salary expected. "Manufacturer," AM. M.

Engineering salesman wanted to take charge of New York office for sales of centrifugal pumps and blowers; should be a graduate engineer; write, giving age, experience, references and salary wanted. Box 607, AMERICAN MACHINIST.

Wanted—Superintendent for long established company manufacturing machine tools of high grade; must be competent to take full charge of machine shop and foundry and direct the designing of special fixtures and new tools; state fully, experience, education, age and salary. Box 513, AMER. MACHINIST.

OHIO

Wanted—Horizontal boring bar and lathe hands; state age, experience and give reference. The Heisler Company, St. Marys, Ohio.

Draftsman and designer, experienced on sheet metal working machinery, power presses, punches, squaring shears, tinners' tools, etc.; growing concern, old established, newly built modern equipped plant; opportunity for advancement for competent ambitious man; must be experienced; state age, experience, reference, salary expected to start with. Box 592, AMERICAN MACHINIST.

Wanted—First class machinists, toolmakers, die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood and metal patternmakers, brass polishers, buffers, finishers, millwrights, hammermen and blacksmiths, who wish to increase their opportunities, to register with the free Employment Department of the National Metal Trades Association, New England Building, Cleveland, Ohio.

PENNSYLVANIA

Works superintendent for old established manufacturing company; must be thoroughly familiar with turret machinery, etc., and modern production methods. Box 586, AM. M.

Wanted—Draftsman and detailer; one who is familiar with machine tool work, and can design and detail small tools, jigs and fixtures; write, stating experience, age and salary expected. Box 610, AMER. MACHINIST.

Wanted—First class automatic screw machine operator; one who is capable of taking charge of entire screw machine room; must be accustomed to setting up and tooling up Cleveland, National-Acme and Gridley automatics; also to direct the work; first class salary to right party. Box 591, AM. MACH.

The Monotype School is maintained to train young men to meet the constant demand for operators of our type casting and composing machine; these operators do so well that we receive more applications for places than can be filled; these qualifications carry most weight: Common sense, automatic machinery experience, printing office experience, type foundry experience. Full particulars will be furnished to inquirers who furnish the same information about themselves, and mention this paper. Lanston Monotype Machine Co., Philadelphia.

SITUATIONS WANTED

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Situation by competent mechanical engineer, experienced as general foreman, chief draftsman and chief engineer; exceptional ability as designer of special machinery, tools, fixtures, etc., and complete equipment for interchangeable manufacture. Box 615, AMERICAN MACHINIST.

ILLINOIS

Manager or superintendent, with practical knowledge of modern manufacturing methods, desires a position; experience includes direction of offices and works, maintenance of plant, motive power, electrical apparatus, etc. Box 565, AMERICAN MACHINIST.

INDIANA

Practical all-around machinist, 35 years old, 20 years' experience, technical graduate, desires mechanical job of responsibility. Box 589, AMERICAN MACHINIST.

MAINE

Wanted—Position as superintendent or foreman by first class man, twenty-three years on general machine work; for five years have had charge of machine shop and tool room. Box 618, AMERICAN MACHINIST.

MASSACHUSETTS

Superintendent of shop owned by the manager. Box 617, AMERICAN MACHINIST.

Mechanical draftsman with experience on gasolene aëro engines, also tool and jig designing, would like position. Box 597, AMERICAN MACHINIST.

Experienced inspector, practical machinist, age 27, wishes position as chief inspector or foreman; familiar with medium and heavy ordnance, steam turbines and marine engines. Box 609, AMERICAN MACHINIST.

Technically educated man, thoroughly familiar with details of scientific management, including planning, time study, rate setting, elimination of waste, etc., desires position as assistant superintendent of manufacturing establishment. Box 602, AMER. MACHINIST.

MICHIGAN

Foreman, expert knowledge of steel treating, uptodate methods for carbonizing, hardening, tempering and machine blacksmithing; high speed steel a specialty. Box 556, AM. M.

NEW JERSEY

Wanted—A position in a country machine shop, or would like to take charge of repair department of boiler or structural shop; 10 years' experience with air compressors, engines and general repairs. Box 596, AM. MA.

NEW YORK

Draftsman, experienced designer, will want position shortly. Box 614, AMER. MACH.

Mechanical engineer, technical graduate, shop experience, designer steam petrol engines, desires position; references. Box 593, AM. M.

Foreman, uptodate on tools, jigs and general manufacture, first class executive, desires change; excellent references. Box 605, AMERICAN MACHINIST.

Factory and cost clerk wishes to change position; five years' machine shop and factory experience; age 26; first class references. Box 603, AMERICAN MACHINIST.

A mechanical engineer with good knowledge of machine design and tools for interchangeable parts, such as adding machines, etc., will consider a responsible position. Box 612, AMERICAN MACHINIST.

Experienced draftsman desires to make a change; ten years' experience on special and automatic machinery; thoroughly familiar with shop methods; location immaterial. Box 619, AMERICAN MACHINIST.

Machine designer and mechanic with 14 years' experience, desires change; capable of designing and getting out special machinery or motor cars from ideas furnished; New York City preferred. Box 547, AMER. MACHINIST.

Production man, all-around mechanic, understand thoroughly use of planers, lathes, milling machines, gear cutters, etc; able to instruct operators and increase results; at present employed; $1500 to $1800. Box 573, AMERICAN MACHINIST.

Mechanical engineer, graduate in Germany, with ten years' designing and shop experience in the line of power plants, turbines, transmissions, hoisting and woodworking machinery, with best references, desires change. Box 604, AMERICAN MACHINIST.

Mechanical engineer, twenty years' experience in engineering educational work, including shops, drafting room, lectures, laboratory and administration, with special reference to mechanics, steam, hydraulic and industrial engineering and power plants, open to engagement at expiration of present term of contract. Box 594, AMER. MACHINIST.

NORTH DAKOTA

Correspondence student desires position as draftsman or detailer. Box 613, AM. MACH.

OHIO

Mechanical draftsman, technical graduate, with six years' varied experience, now employed as checker with a well known motor truck manufacturing concern; age 32; single. Box 588, AMERICAN MACHINIST.

Office man, 26, ten years' experience, desires responsible position with growing concern; capable correspondent; expert stenographer; thoroughly familiar with machine tools. Box 616, AMERICAN MACHINIST.

An experienced designing draftsman is open for position; 20 years' experience on Corliss steam engines, air compressors and rock drills; ambitious and capable; references, A-1. Box 577, AMERICAN MACHINIST.

PENNSYLVANIA

Mechanical engineer seeks position as master mechanic or superintendent; seventeen years' varied experience; uptodate on modern methods; good organizer and systematizer. Box 526, AMERICAN MACHINIST.

WISCONSIN

Superintendent desires change; now engaged in machine tool building; broad experience in general machine work; am able designer of jigs and special tools; can increase efficiency of men and machines; 17 years' practical experience with leading manufacturers; 10 years in charge; a very capable executive and can make good in any position of responsibility; age 34; American. Box 595, AMERICAN MACHINIST.

FOR SALE

One large size new Sanford portable welding machine at sacrifice. Box 578, AM. MA.

Manufacturing business; outright or part; dies, presses and special machinery; established trade with best concerns in the United States; reason sickness. Box X-40, AMERICAN MACHINIST, 150 Michigan Ave., Chicago.

For Sale—32 horsepower and 14 horsepower Backus gas engines, line shaft and other equipment; Bliss No. 30½ combination back geared and direct drive punch press; all of the above machines in the best of condition; can be seen at any time. Ellis Adding Typewriter Co., 204 Morris Ave., Newark, N. J.

For Sale—135 kilowatt Fort Wayne generator, direct connected to Ide engine; 200 horsepower Heine boiler; 150 horsepower return tubular boiler; several large size American Blower Company force draft fans and feed water regulator; all in first class condition. Address Textile Machine Works, Reading, Penn.

For Sale—National-Acme four-spindle automatic screw machine, No. 515, original capacity up to 9/16 inch, but this is fitted to take ⅝-inch rods; new last summer, been run about three months; in first class condition; cost with equipment, $1100; will sell for $800, f.o.b. Boston, Mass., as we have discontinued line of work this was used on. Box 608, AMERICAN MACHINIST.

Talks With Our Readers

By The Sales Manager

Somebody has asked why we refer so often on this page to advertising.

Simply because it is the least understood and one of the most powerful forces in the civilized world today.

It's a power that touches intimately the life of every man and woman.

In 1902 Charles Austin Bates wrote:

We all advertise. The infant's inarticulate gurgles advertise most effectively for board and lodging.

Our sons and daughters are well advertised at the head of their classes, and Mr. Kipling's "flanneled fools at the wicket" are advertised in their prowess, and perhaps their pulchritude, to all who will see.

"Mr. Smith, allow me to present my friend, Dr. Scalpel."

More advertising.

"Mrs. Gramercy Parke: Tuesdays in April." Advertising of a most subtle sort—for Mrs. Parke's friends block her street with their carriages, and their number advertises the success of her reception.

The diamonds of Mrs. Lenox Newport, and the laces of Mrs. Washington Square and the gowns of Mrs. Plaza Van Netherland convincingly express their prosperity and their taste.

We all advertise.

It is one thing all of us do. Some of us crave caviar, and like port with our cheese, and some of us do not. But in some way or other—always or seldom—we advertise our smartness, our wisdom, our wit, our wealth and our familiarity with Prince Henry and the Captains of Industry.

The fact that what we advertise mostly doesn't amount to much—doesn't amount to much.

We want gold on our harness and a putty-faced footman for advertising. For surely we would physically be just as comfortable with nickel-plating, and it may be difficult to live up to the footman's idea of what we ought to be.

We are seen at the opera partly for the music and largely for the bluff.

We choose our pictures and the decoration of our houses with one thought to our own inclinations and another to our friends' opinions.

If our magnificence creates conversation the advertising is successful.

Much money is expended for advertising businesses, but more for advertising personalities.

The high hat is the assertion of prosperity and advertises its wearer into the consideration he might not otherwise receive.

The presentation of a $600,000 collection of porcelains to the Art Museum, and the giving of $10,000,000 for libraries is advertising, commendable, useful, desirable advertising, and positively worth the money.

Around the club table, over the highballs, we swell out our chests and talk about the price of "Steel" and "B. R. T." just as if it really interested us, and so by inference we advertise that we are quite some large pumpkins in the stock market.

And when we die!

Flowers, tears, hearses with plumes and horses with black fringe around them, mourners, and carriages, preachers and eulogies and things advertise our greatness and the grief of our heirs.

And, finally, they put a ton or so of granite immediately above our swelling bosoms to keep the grave from bursting with our pride, and in letters of imperishable stone they carve upon it an advertisement of our manifold virtues.

So our life begins with a help wanted ad and ends with a testimonial. And all is advertising—

But there are a lot of things done in the name of advertising that are only the *crimes* of advertising.

* * *

The public is beginning to sit up and say, "I want to know and I'll be friends with those who tell me."

Advertising means going to the public with a message of what you can do for them—*creating a favorable impression.*

Advertising is one of the greatest ethical forces in business today, because dishonest products and dishonest methods cannot stand advertising.

Advertising is the honest man's greatest bulwark. It is the dishonest man's greatest bugaboo.

It's a power for *better* business, as well as bigger business.

It's a force working day and night for commercial uprightness.

It steadies trade, steadies quality, raises the standard of living—is in reality a great educational force.

All of us don't fully appreciate this—but we shall in time.

We shall get accustomed to using the advertising of our technical paper just as we do any other tool that will help us in our work.

* * *

The selling section of the AMERICAN MACHINIST is an integral *part* of the paper.

While it enables us to sell the paper at a far lower price than would otherwise be possible, it is not given to you in *addition*, but as a *part* of what you pay for.

Just so long as we can make it interesting and profitable to *you*, will you more and more give it the attention it deserves.